SEPTEMBER 6, 1954

Electrical World

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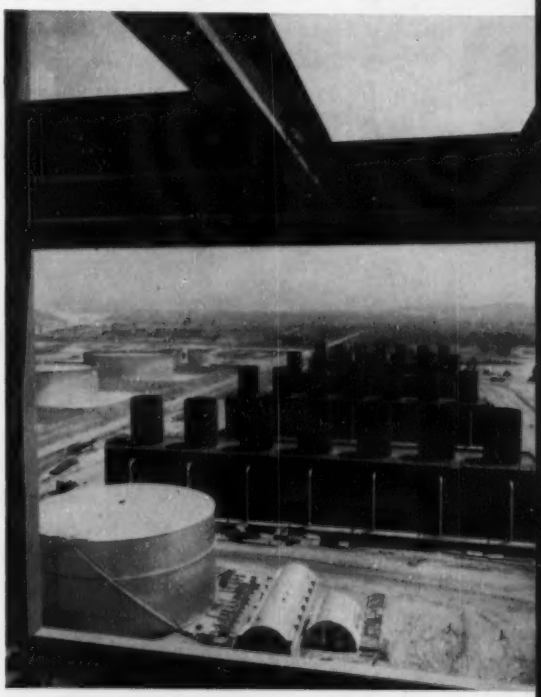

COOLING TOWERS

. . . are rapidly becoming a part of the picture at generating stations in many areas. For a special Electrical World Survey of the statistics of 52 such installations

see page 91

HOW TO a regular service for electric utility men who want practical ideas on how to design, construct, operate, and maintain begins on page 99

Does your regulator meet the test?

Compare FOR YOURSELF

Thirty days of free examination: that's how Allis-Chalmers helps you decide which regulator is best for your system. Any recognized distribution system can get an Allis-Chalmers distribution regulator completely free of charge for testing. Call in your engineers, purchasing people, operating and maintenance men and let them see for themselves which regulator is best. Compare all the features.

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Get complete information. Better yet, get a regulator you can test for yourself. Call your nearby A-C office or write Allis-Chalmers, Milwaukee 1, Wisconsin, for a test regulator and for the recently published "regulator check list" that will help you analyze all regulators.

A-4356

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A-C ALLIS-CHALMERS

Electrical World

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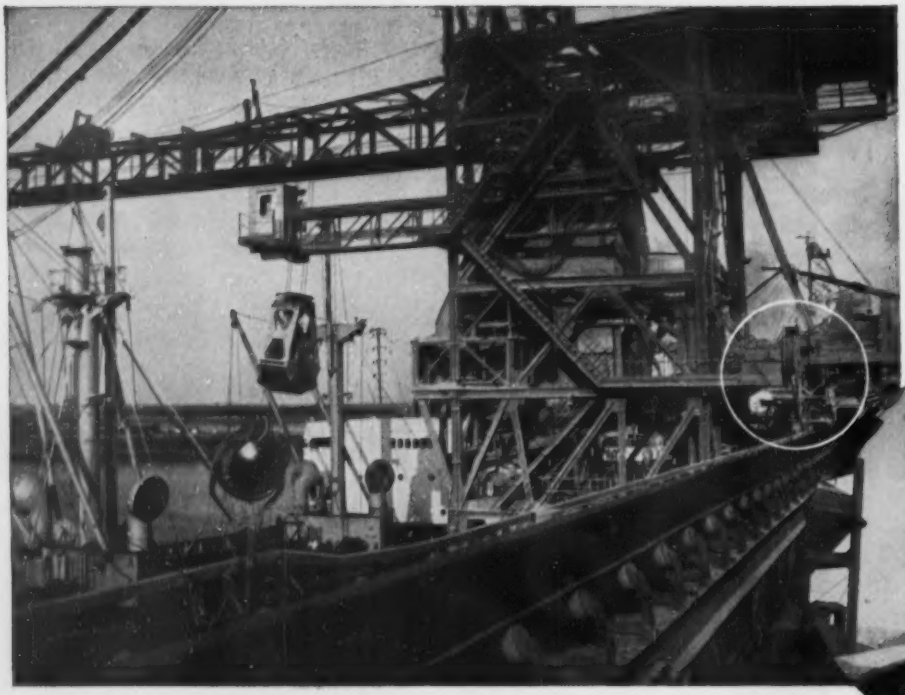
Published weekly by McGraw-Hill Publishing Company, Inc., James H. McGraw (1860-1948), Founder. Publication Office, 99-129 N. Broadway, Albany 1, N. Y. Executive, Editorial and Advertising Office, McGraw-Hill Building, 330 W. 42nd St., New York 36, N. Y. Donald C. McGraw, President; Willard Chevalier, Executive Vice-President; Joseph A. Gerardi, Vice-President and Treasurer; John J. Cooke, Secretary; Paul Montgomery, Executive Vice-President, Publications Division; Ralph B. Smith, Vice-President and Editorial Director; Nelson Bond, Vice-President and Director of Advertising; J. E. Blackburn, Jr., Vice-President and Director of Circulation.

Subscriptions: Address correspondence to Electrical World—Subscription Service, 99-129 North Broadway, Albany 1, N. Y. or 330 W. 42nd St., New York 36, N. Y. Allow one month for change of address.

Subscriptions are accepted only from executive, supervisory, and engineering personnel in electric utilities, manufacturing companies, and related fields. Position and company connection must be indicated on subscription orders.

Single copies 35c. For the United States and possessions $6 a year, $9 for two years, $12 for three years. Canada, $7 for one year, $11 for two years, $14 for three years. (Canadian money, at par.) Other Western Hemisphere, and the Philippines, $15 for one year, $25 for two years, $30 for three years. All other countries $25 for one year, $40 for two years, $50 for three years. Entered as second-class matter, November 16, 1936, at the Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in USA. Copyright 1954, by McGraw-Hill Publishing Company, Inc. Permission required to reproduce any of contents.



Alabama State Docks Bulk Material Handling Plant utilizes Hazacord in a unique take-up reel feeder for the overhead loading structure.

Close-up of the take-up reel shows the supporting bars for the cable alongside the conveyor belt.

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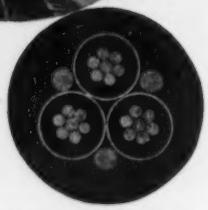

Hazacord Type SH-D

Overhead loading structure power distribution at the new addition to the $5,000,000 Alabama State Docks Bulk Material Handling Plant at Mobile required a high safety factor as well as long-term dependability. Previous construction involved contactors riding on open bus bars which were frequently damaged by falling ore and were hazardous to personnel.

A constant torque take-up reel equipped with 650 feet of Hazacord Type SH-D supplies the power to the new loading structure. The 5,000-volt cable is supported as it is paid out by 14" rods extending out from the side of the conveyor belt at 5' intervals. The structure can move 630' in either direction from the origin of the cable.

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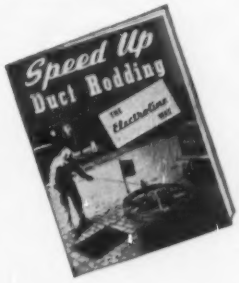

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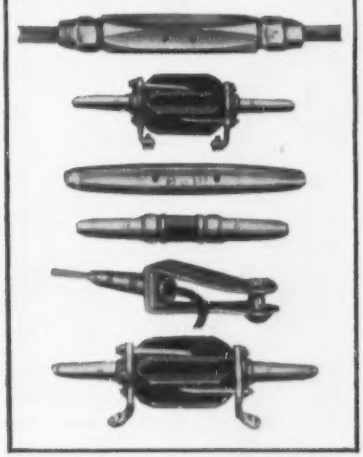

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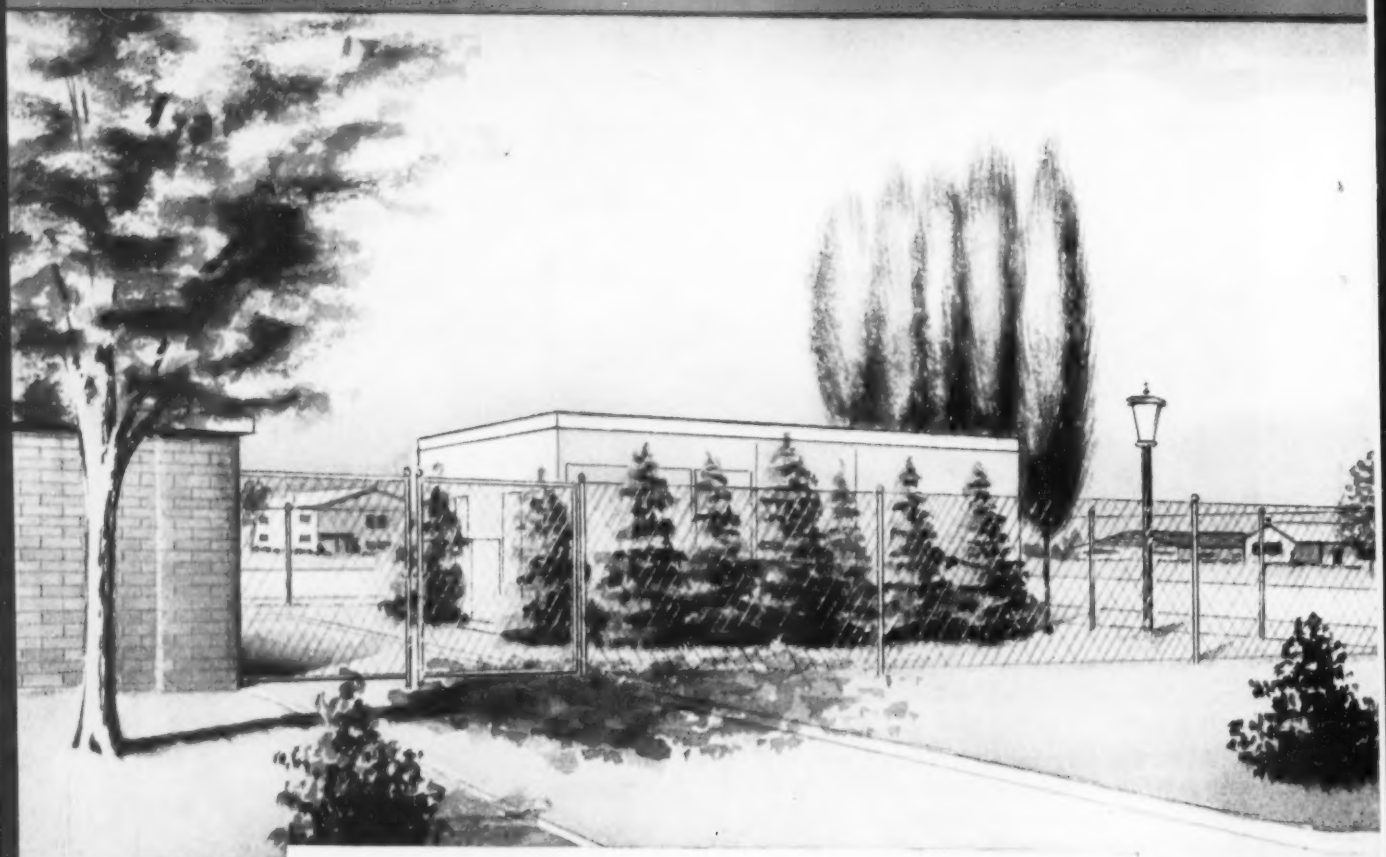

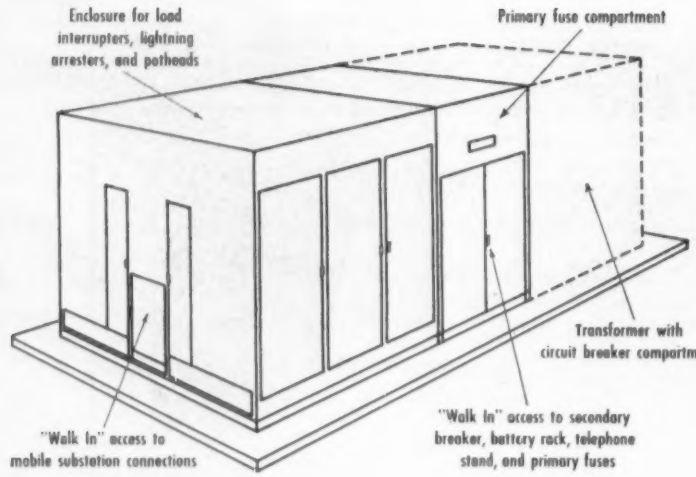
Enclosure for load interrupters, lightning arresters, and potheads
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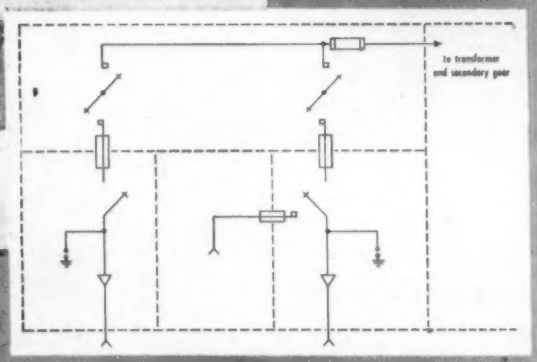

Circuit diagram of the S&C Metalclad Primary Gear for the distribution substation illustrated. The gear is equipped with Type SM Power Fuses and Alduti Type Load Interrupters with provision for remote control operation.

Incorporated in the unit on the left are these operating features:

1) Pothead isolation—for protection of operators during maintenance

2) Disconnecting provisions to isolate load interrupters, to by-pass entire substation, and to feed mobile substation

3) Integral housing of control panels, battery rack, work stand, telephone stand. Elimination of need for unsightly tool shacks

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5) Unit capsuled for shipment in one piece

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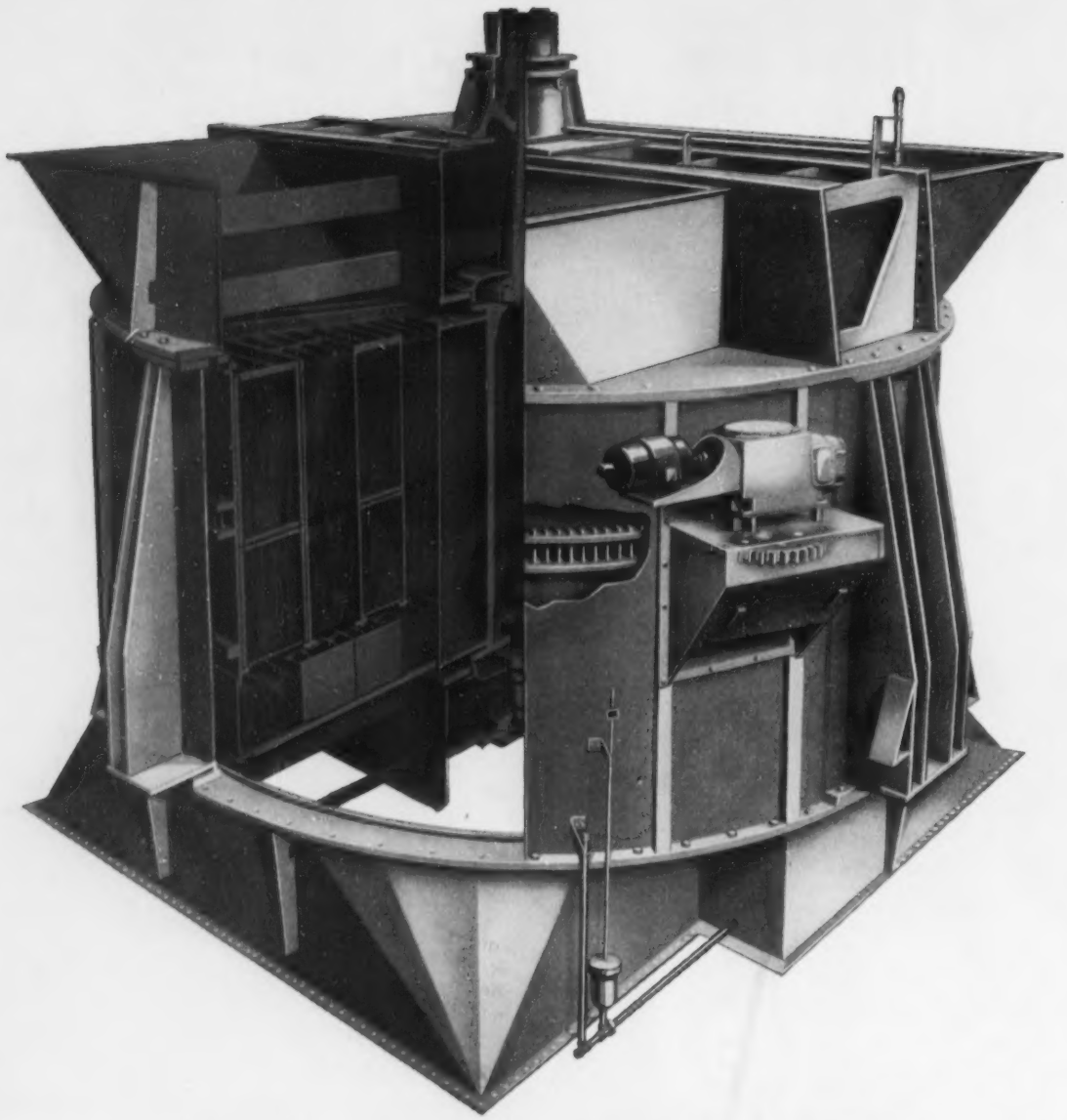

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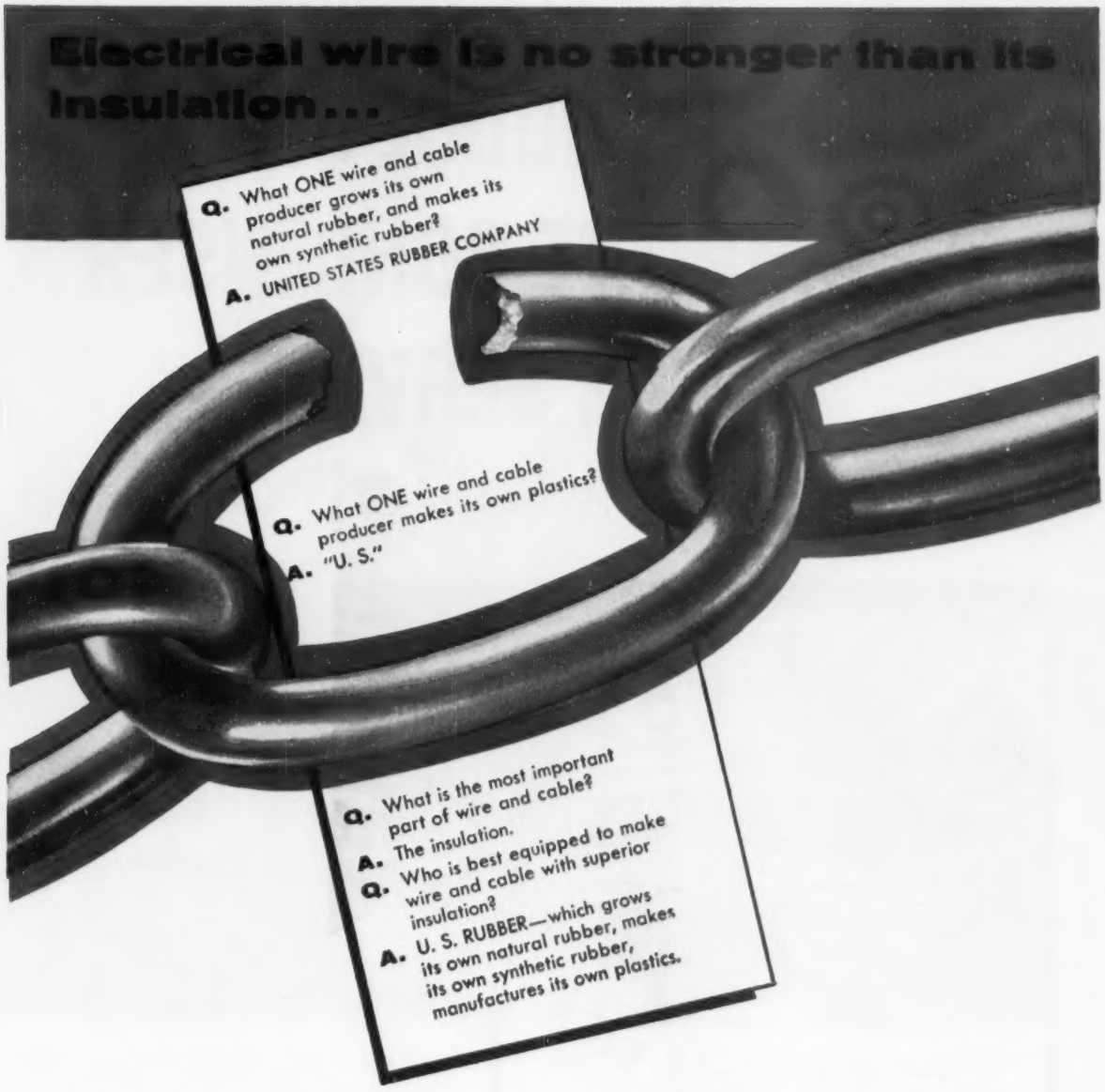
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A. UNITED STATES RUBBER COMPANY
Q. What ONE wire and cable producer makes its own plastics?
A. "U. S."
Q. What is the most important part of wire and cable?
A. The insulation.
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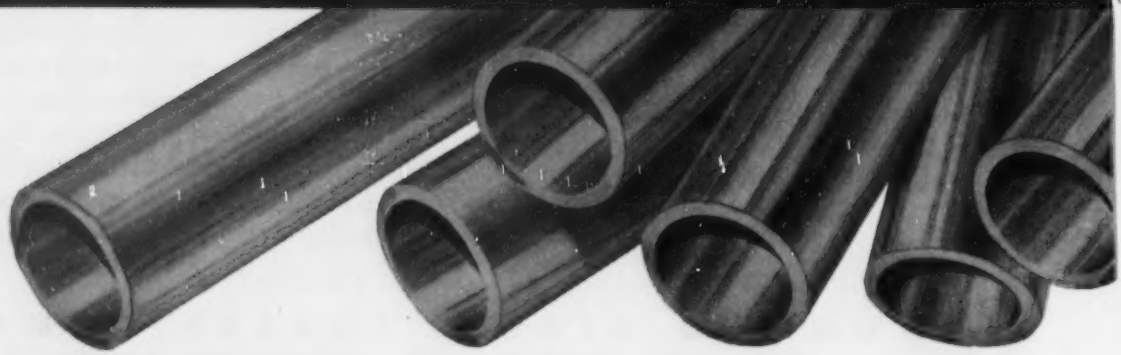

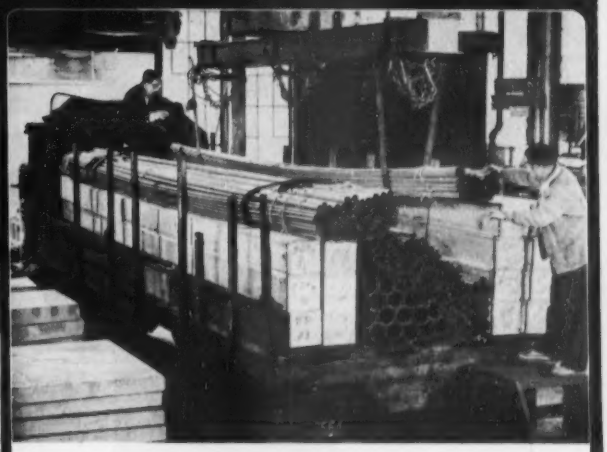

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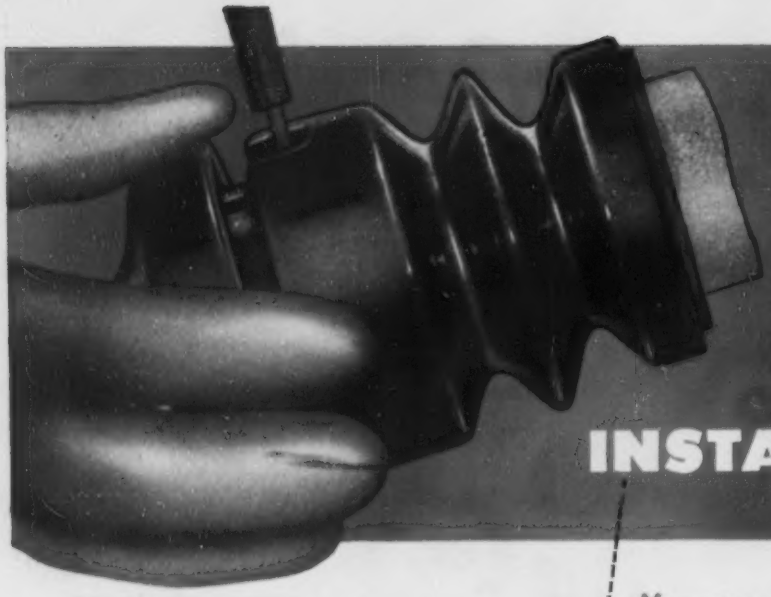

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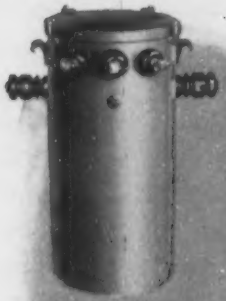

Type A, OISC conventional distribution transformer, 15 KVA, single-phase, 60-cycle, with side wall mounted high voltage bushings. Standard construction for voltages 5 KV and less, and sizes through 100 KVA.

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Type CSP, OISC distribution transformer, 15 KVA, single-phase, 60-cycle, with primary lightning arresters, internal fuses, low voltage circuit breaker and side wall mounted high voltage bushings. Standard construction for voltages 5 KV and less and sizes through 100 KVA.

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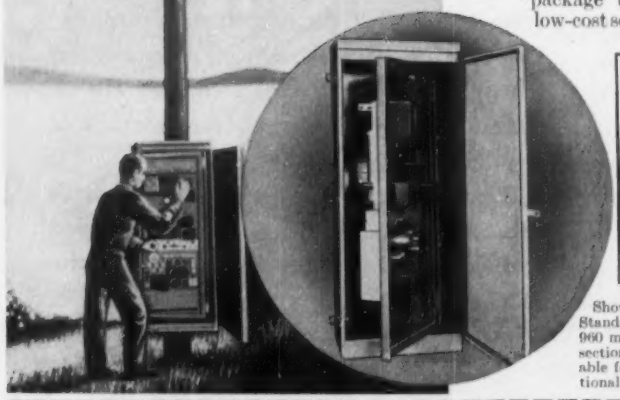

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Dependable lighting has to be more than good looking, scientifically designed lighting fixtures. The power cables are part of it too. Such cables must be able to withstand winter thaws and freeze-up, as well as summer rains. They must also withstand high summer heat and winter cold.

ANHYDREX Series Street Lighting Cables do this and more. They can be buried in the ground or pulled through ducts. Sometimes they are used inside the lighting standard. But regardless of how they are used, they are dependable. They require no lead sheaths or metallic armor.

Want to know more about these versatile street lighting cables that can be used overhead or underground with or without ducts? Write us directly or contact our representative in your area for more detailed information.

Simplex–ANHYDREX Series Street Lighting Cables

SIMPLEX WIRE & CABLE CO., 79 Sidney Street, Cambridge 39, Mass.

FULL GRIPPING SURFACE

with BLACKBURN *Aluminum* SERVICE WEDGE CLAMP

Conductor is in Contact with Wedge for Entire Length of Slider

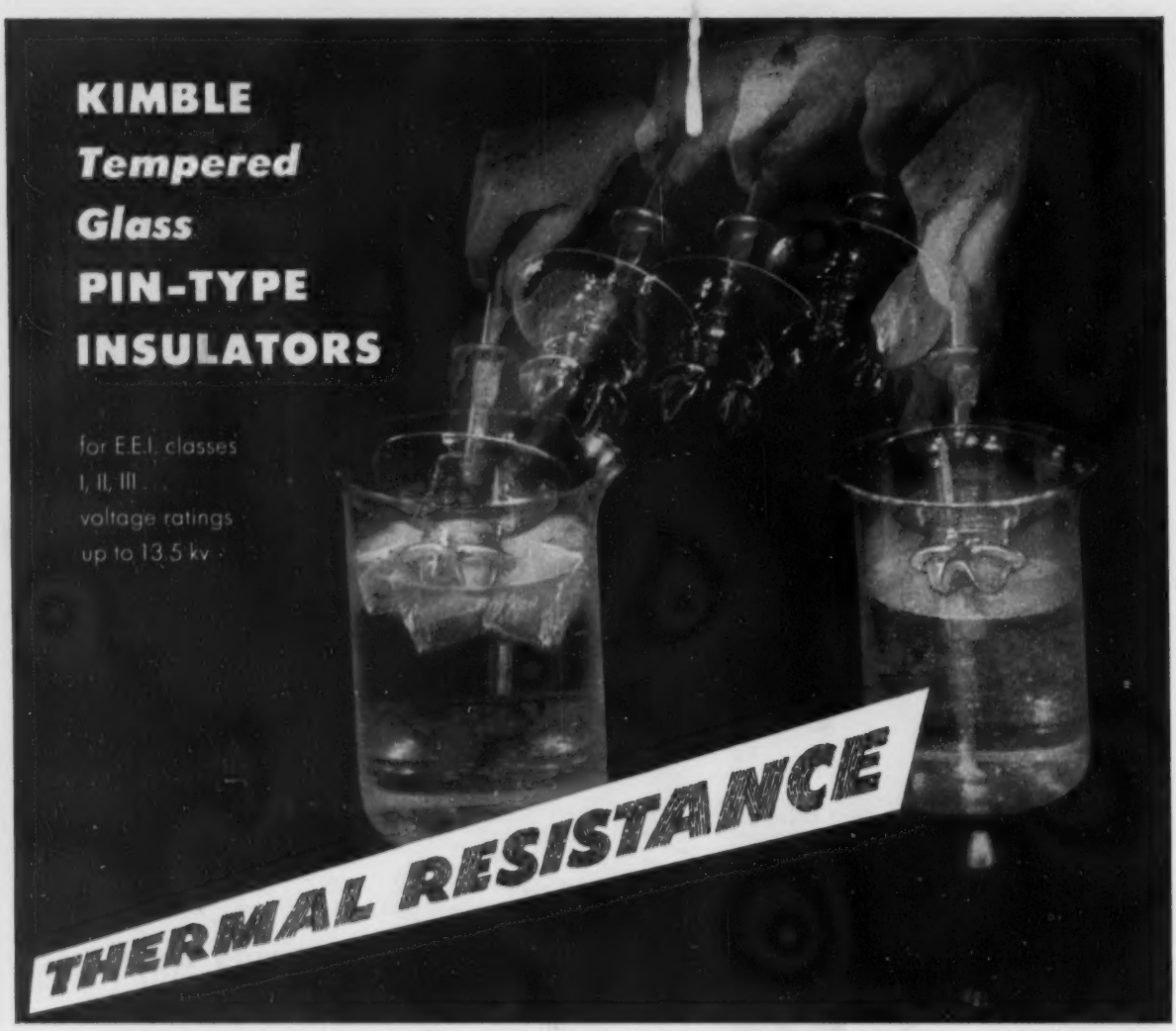
This longer-contact gripping surface adds years of trouble-free life to the connection. *It's easily installed.*

- **Stainless steel bail can be snapped on and off without tools. Its strength exceeds rated breaking strength of conductors.**
- **Removable aluminum slider allows clamp to be installed without threading through clamp.**
- **Drop wire can be pre-sagged and cut to exact length—saves conductor—saves time.**
- **Clamp can be attached to bare neutral at any point in the span.**

The BLACKBURN Aluminum Service Wedge Clamp covers a conductor range of 2-6 sol, Aluminum and 4-6, ACSR. The wedge and bail are Stainless Steel—the removable slider, heat-treated Aluminum.

Available through electrical wholesalers everywhere

JASPER BLACKBURN CORPORATION
35 Madison Street • St. Louis 6, Mo. • Phone MAin 1-2821



NO CHIPS, CRACKS, OR SPALLS

Laboratory tests to determine the thermal resistance of Kimble *Tempered* Glass Insulators produced no chips, cracks or spalls even after 10 cycles from 40° to 200° F cold-to-hot, hot-to-cold. This high thermal resistance is further demonstrated by their service in the field where they have proved to have unusual resistance to heavy power arcs.

Kimble *Tempered* Glass Insulators save installation time because it's never necessary to loosen up for line-up with the conductor. Their great strength always allows another quarter-turn.

If it's on the pin, it's in service

Tests far in excess of A.I.E.E. standards have proved it impossible to puncture a Kimble *Tempered* Glass Insulator in air. Even lightning surges have failed to damage them. In the event of shattering due to severe mechanical shock, insulator disintegrates into small, non-sharp fragments. Trouble shooters can locate broken insulator—fast.

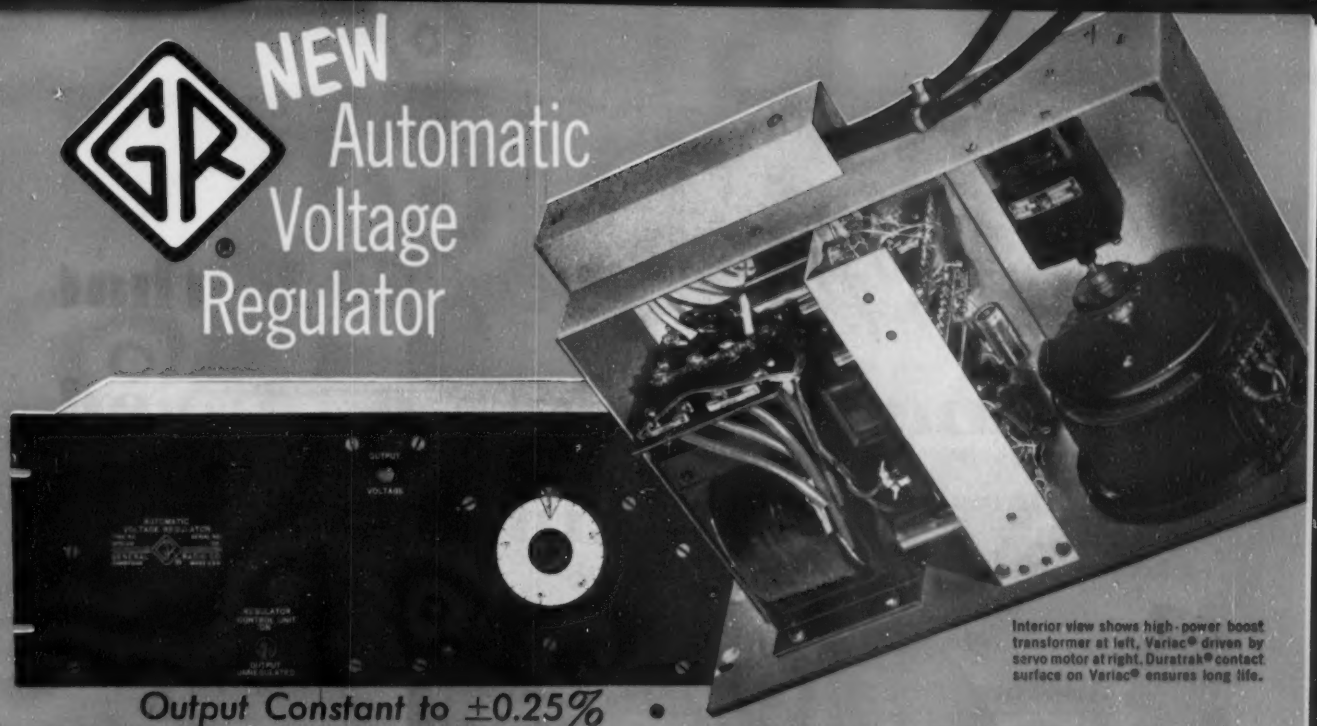
What's the secret? *Tempering*, a Kimble development in glass insulators that adds a new element to the many natural virtues of glass insulators. Kimble insulators are more than strong enough to meet the severe tests required.

Why not see how *tempered* glass can cut your line maintenance costs. Write for the new descriptive folder that gives complete details. Address: Kimble Glass Company, subsidiary of Owens-Illinois, Department EW-9, Toledo 1, Ohio.

KIMBLE INSULATORS
AN (I) PRODUCT

OWENS-ILLINOIS
GENERAL OFFICES · TOLEDO 1, OHIO

NEW Automatic Voltage Regulator



Interior view shows high-power boost transformer at left, Variac® driven by servo motor at right. Duratrak® contact surface on Variac® ensures long life.

Output Constant to ±0.25%
Extra Fast Response: 0.1 sec. per volt
Handles up to 6 KVA

For a Detailed Description of this New Instrument, write for the July Issue of the General Radio Experimenter

The Type 1570-A Automatic Voltage Regulator combines *Accuracy* for laboratory use with *High Power-Handling Capacity* for control of industrial processes.

The application of proportional-control servo-mechanisms to voltage regulator design has resulted in a unique, highly-efficient instrument which should prove of considerable value to those requiring constant a-c line voltage.

This Regulator consists essentially of a Variac® continuously-adjustable autotransformer, a servo-mechanism sensing circuit which samples the output voltage, and a servo-motor which varies the Variac to correct for input line-voltage changes. This instrument is rugged, requires minimum maintenance, — the G-R trademark guarantees it's been *engineered and built right*.

Features you get with the GR 115-volt, 60-cycle Automatic Voltage Regulator . . .

SPEED *This instrument does things in fractions of a second — response is 10 volts per second*

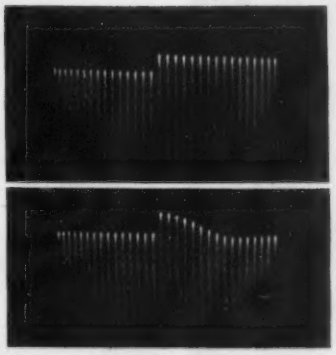
HIGH ACCURACY *Output held constant to within ±0.25% of voltage selected*

±10% SELECTION IN OUTPUT VOLTAGE *Output may be set for any desired value from 104 to 127 volts*

CORRECTS LINE VOLTAGE FLUCTUATIONS OVER WIDE RANGE *±10% of selected output voltage, ±20% or ±40% at reduced accuracy and power rating*

HIGH POWER *Handles 50-amps (6 KVA)*

EXCELLENT TRANSIENT RESPONSE *Adjustments permit setting response characteristic desired — adjustable for no overshoot (see oscillograms)*



Oscillograms illustrate high-speed response of typical G-R Automatic Voltage Regulator. Illustrated at top, is sudden 1% change in 60-cycle voltage input to Regulator. Bottom oscillogram shows instrument correcting for this change in 8 cycles (0.13 seconds)

ADDS NO HARMONIC DISTORTION *Unlike most saturable-core reactors*

SUPPLIES ANY LOAD *No restrictions on power factor*

EFFICIENCY *Better than 98%*

VOLTAGE CORRECTION INDICATED *Panel dial provides continuous indication*

USEFUL FOR CONTROL OF THREE-PHASE POWER *three of these instruments in conjunction will control both amplitude and phase of three-phase systems*

WEIGHT *55 lbs* DIMENSIONS *19" x 7" x 12⅞"*

Type 1570-A Automatic Voltage Regulator
. . . supplied in either 115-v or 230-v model

Type 1570-ALM (115v) Table-Top **$470.**
Type 1570-AHM (230v)

Type 1570-ALR (115v) Relay-Rack **$465.**
Type 1570-AHR (230v)

We sell direct. Prices shown are NET, f.o.b. Cambridge or W. Concord, Mass.

GENERAL RADIO Company

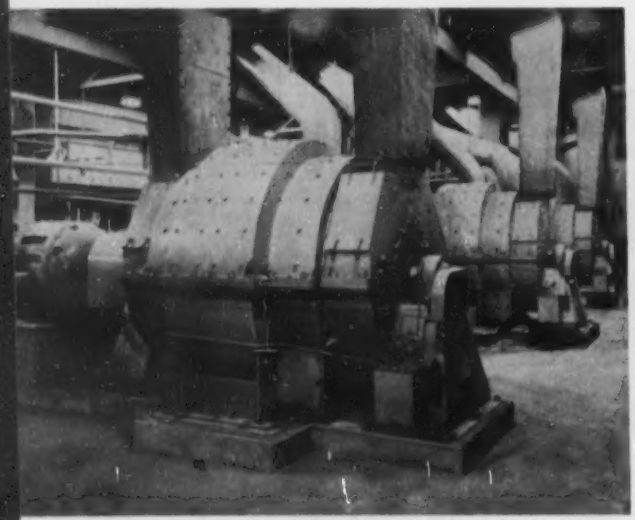
275 Massachusetts Avenue, Cambridge 39, Massachusetts, U.S.A.

90 West Street NEW YORK 6
8055 13th St., Silver Spring, Md. WASHINGTON, D. C.
920 S. Michigan Avenue CHICAGO 5
1000 N. Seward Street LOS ANGELES 38

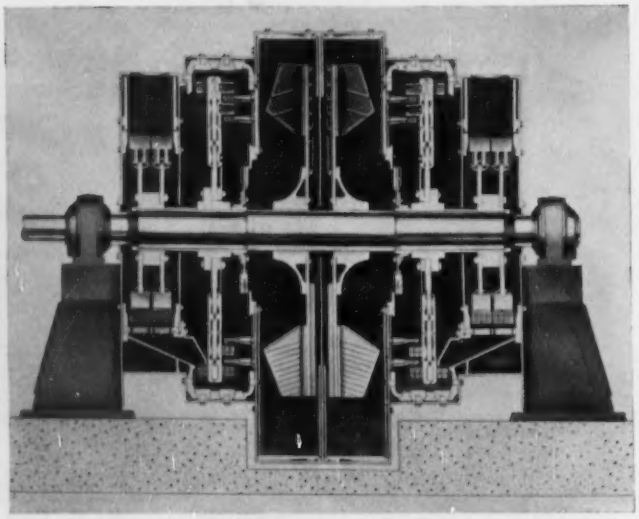
ADMITTANCE METERS
AMPLIFIERS
COAXIAL ELEMENTS
DISTORTION METERS
FREQUENCY MEASURING APPARATUS
FREQUENCY STANDARDS
IMPEDANCE BRIDGES
LIGHT METERS
MEGOHMMETERS
MODULATION METERS
MOTOR CONTROLS
NULL DETECTORS
OSCILLATORS
PARTS & ACCESSORIES
POTENTIOMETERS
PRECISION CAPACITORS
PULSE GENERATORS
R-L-C DECADES
R-L-C STANDARDS
SIGNAL GENERATORS
SOUND & VIBRATION METERS
STROBOSCOPES
TV & BROADCAST MONITORS
U.H.F MEASURING EQUIPMENT
UNIT INSTRUMENTS
VARIACS
V-T VOLTMETERS
WAVE ANALYZERS
WAVE FILTERS

Here's *positive proof* that tungsten carbide faced pulverizing elements in Riley "50" Pulverizers can *take it!*

Maintenance of Riley "50" Pulverizers is simple. Engineer easily removes and replaces pulverizing pegs.



Two batteries of three Riley Duplex "50" Pulverizers each serve two 700,000 lbs./hr. Riley Steam Generating Units at Albright Station. Monongahela Power Co. — The Potomac Edison Co. Every twenty-four hours approximately 3.5 million pounds of deep and strip mine coal containing 720 thousand pounds of ash and shale are pulverized in these rugged units. Required fineness is maintained despite the extremely abrasive materials in the coal and the large quantities of coal pulverized.



At Albright Station, engineers report that even when water actually runs out of the pulverizer feeders, the flash drying characteristic of the crusher-dryer sections (extreme ends of illustrations) dries coal so efficiently that pulverizer capacity is unaffected. Foreign particles and tramp iron are also rejected in these sections. The design of Riley "50" Pulverizers assures quiet, vibrationless operation. Riley "50" Pulverizers are available in capacities from 5,000 to 50,000 pounds per hour.

. . . this Tungsten Carbide faced moving peg was removed from a Riley "50" Pulverizer that had pulverized during a fourteen month period 130,000 tons of West Virginia strip and deep mine coals *averaging 20% ash content.*

unretouched photographs actual size

and it's still good for many more tons!

Compare . . .

Here is a brand new peg . . . notice how little tungsten carbide on the used peg (above) has worn off . . . actually less than 1/3 of the tungsten carbide facing. Low maintenance is one reason why Riley "50" Pulverizers have been installed by so many industrial and utility companies.

Your Riley Representative can furnish you with complete information about the Riley "50" Pulverizer or write direct to Riley Stoker Corporation for catalog.

RILEY *Stoker Corporation*

WORCESTER, MASSACHUSETTS

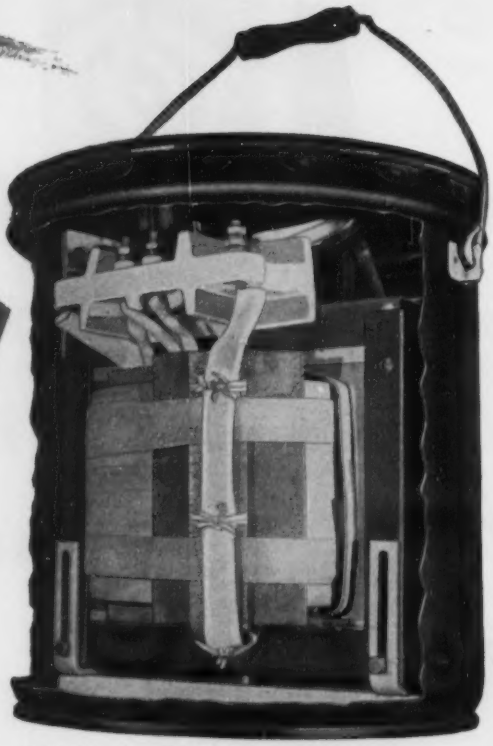
Boston New York Philadelphia Buffalo Washington Pittsburgh Cleveland Detroit Chicago Cincinnati Charlotte New Orleans
Atlanta St. Louis Kansas City St. Paul Tulsa Houston Denver Salt Lake City Los Angeles San Francisco Portland Seattle

COMPLETE STEAM GENERATING UNITS

AND FUEL BURNING EQUIPMENT FOR PUBLIC UTILITIES, INDUSTRIAL POWER AND HEATING PLANTS

Quick repair for burned-out transformers

Wagner Replacement Core and Coil Assemblies come to you *Ready to Install* —without testing or drying—packaged in transformer oil for complete protection



Wagner has the answer to the problem of renewing or up-rating old or burned out transformers. Specify the packaged Form W core and coil assembly . . . a brand new element, exactly like those used in new Wagner Transformers.

These replacement elements come ready for use—fully dried and tested—protected in a sealed container filled with Wagner 7-NI inhibited transformer oil, which you may also use in your tank. Available in ratings from 3 through 167 kva.

Installation is easy . . . the assemblies are complete with terminal board or tap changer, with leads ready to install in your tank. Each assembly has a new serial number and name plate.

Wagner Bushing Assemblies

High Voltage Bushing Assembly

Available in cover-mounted or tank wall mounted types to meet a wide range of requirements. Gasket, solderless connector-type terminal and clamping devices are included—fuses can be furnished when specified.

Low Voltage Bushing Assembly

Ready to install—includes porcelain bushing, gasket, solderless connector-type terminal and clamping device.

Field Repair Service for Substation Transformers

Wagner's Transformer Service Trucks—completely equipped for field repairs—each with the services of an expert—are available on schedule in most localities. The cost of this exclusive Wagner service is nominal—write for information.

WAGNER ELECTRIC CORPORATION
6456 Plymouth Ave., St. Louis 14, Mo., U.S.A.

Wagner Electric Corporation EST. 1891

ELECTRIC MOTORS • TRANSFORMERS • INDUSTRIAL BRAKES
AUTOMOTIVE BRAKE SYSTEMS — AIR AND HYDRAULIC

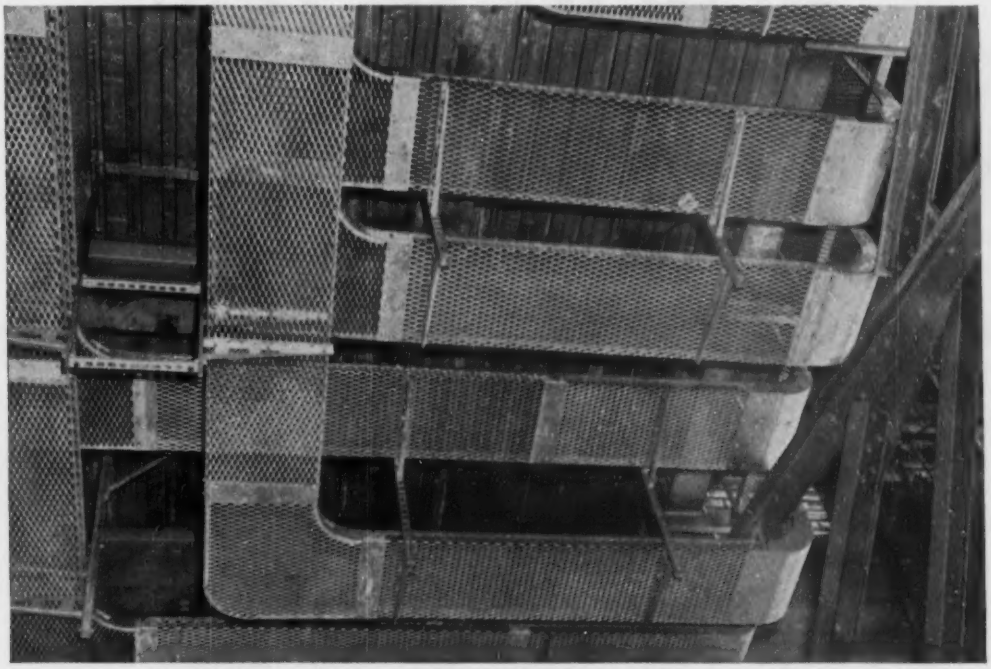
BRANCHES IN 32 PRINCIPAL CITIES

TS 53-1

T. J. COPE, INC.

711 SOUTH 50TH STREET, PHILADELPHIA 43, PA.

Standard systems of trough and fittings for supporting power and control cable.
— For over 65 years, Manufacturers of Tools and Equipment for
Installation of Underground and Overhead Electric Cables



Cope Cable Trough installed at Ohio Edison Company, Niles Station. Hatzel & Buehler, Electrical Contractors.

The Cope Standardized Systems of Cable Trough is a simple, sturdy, time and labor saving construction for the support of electrical power and control cables. Hundreds of engineers and contractors have realized the advantages to be gained through the use of this trough in leading industrial plants and utility generating stations.

Practically any layout problem can be met. Sturdy raceways of varying widths, at different levels and in any direction are easily installed. They can pass around, over or under obstructions and change from one size trough to another. For very unusual conditions, special fittings can be designed and fabricated.

Standard straight trough is in 8' lengths and in 3", 6", 9", 12", 18", and 24" widths. Trough is 1½" or 3" high including steel binding strip. Covers are also available. Assembly requires only the use of nuts and bolts which are supplied. All parts are hot dip galvanized. Write for Bulletin 9W for full details.

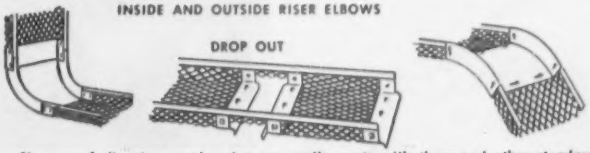
COPE STANDARD FITTINGS

. . . in the Horizontal Plane

TEE ELBOW REDUCER

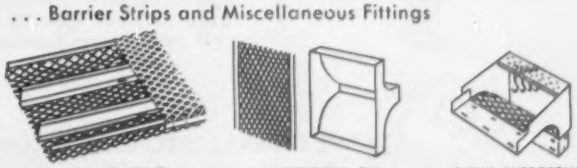
All fittings have radius corners to protect the cable from damage during installation and insure a neat finished job.

. . . in the Vertical Plane



Changes of direction or elevation are easily made with these and other standard fittings shown in Bulletin 65A. Write for it.

. . . Barrier Strips and Miscellaneous Fittings

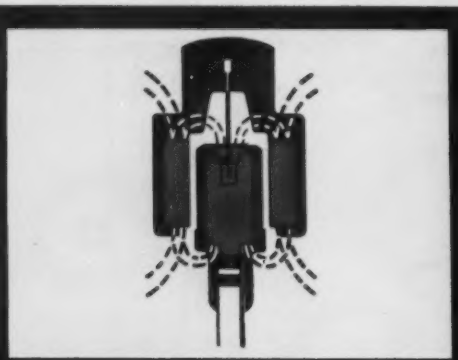


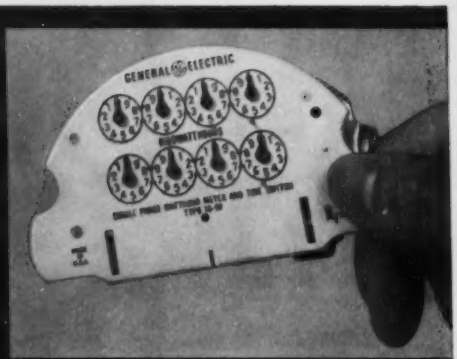
BARRIER STRIP VERTICAL TEE CABLE SUPPORTING RISER ELBOW

Another new member of the I-50 family

7 REASONS WHY THIS NEW G-E METER*

WILL LOWER YOUR METERING COSTS

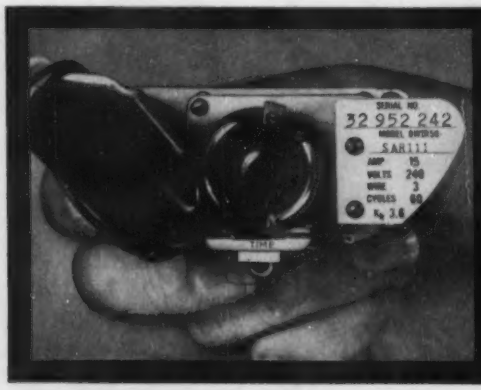


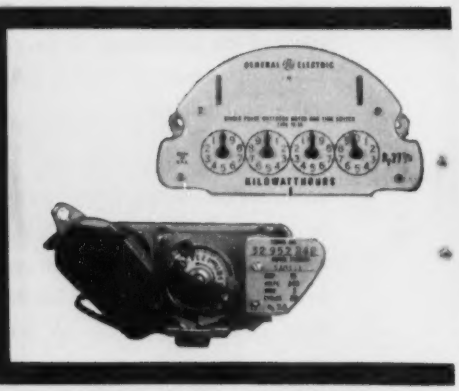


1 **NEW TYPE IR-50** for off-peak control incorporates the many features of the G-E I-50 meter to bring you greater dependability and accuracy.

2 **MAGNETIC SUSPENSION SYSTEM,** identical to the I-50 watthour meter's "floating disc," eliminates bearing wear and thus keeps maintenance costs to a minimum.

3 **NEWLY REDESIGNED REGISTER,** either single or double rate, has maximum legibility and accuracy. Resetting is simplified with individual plungers.



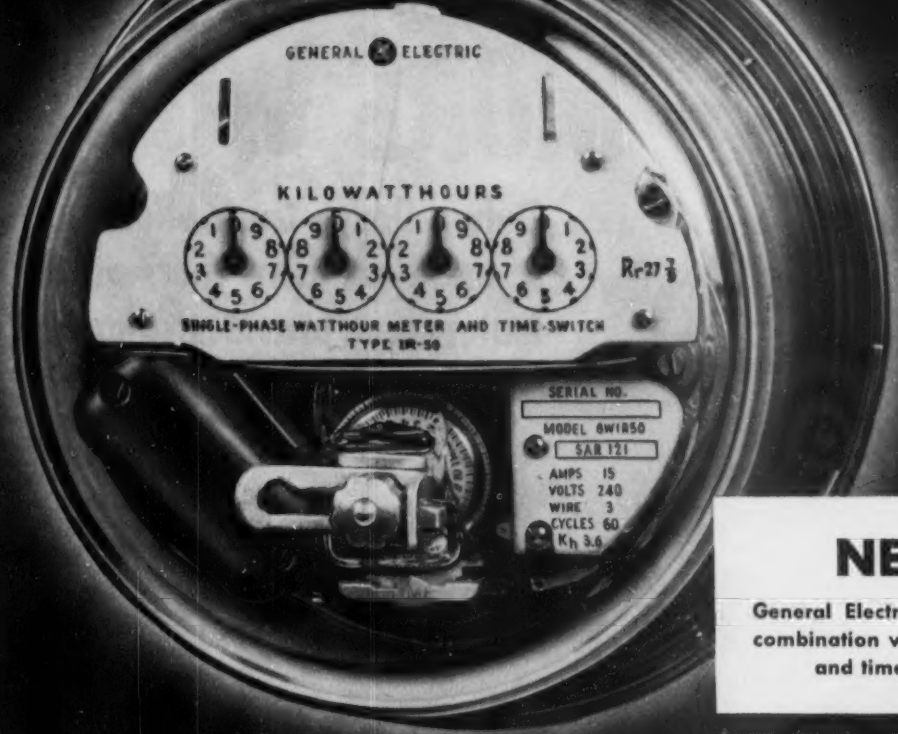


4 **IMPROVED TIME SWITCH** mechanism in new IR-50 incorporates 40-ampere silver contacts and Type SG-2 timing motor with the time-proven Telechron** rotor for longer life.

5 **TIME SWITCH AND WATTHOUR REGISTER** are separate assemblies and can be removed from meter independently, making maintenance easier.

***THE GENERAL ELECTRIC IR-50 COMBINATION WATTHOUR METER AND TIME SWITCH** is the newest member of the I-50 family. For a sample demonstration, or for more information, contact your nearest G-E representative or write: Section 601-100, General Electric, Schenectady 5, N. Y.

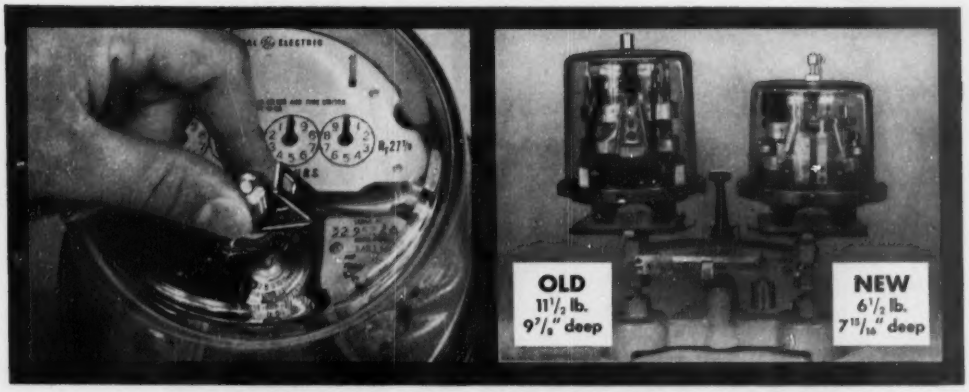
**Reg. Trade-mark of General Electric Company.



NEW

General Electric Type IR-50 combination watthour meter and time switch

NEWEST MEMBER of the General Electric I-50 family, the IR-50 meter registers and controls off-peak water-heater loads. Proven I-50 meter features such as stability of calibration, inherent accuracy, co-ordinated insulation, surge protection mean lower operating costs.



6 **NO SCREWDRIVER IS NEEDED** for setting time dial on IR-50. External reset knob, which can be easily sealed or locked, facilitates setting.

7 **COMPLETELY NEW DESIGN** of the G-E IR-50 meter, ⅛ smaller, and little more than half the weight of older types, means lower handling costs and faster, easier installation.

GENERAL ELECTRIC

Gives you MORE POWER...
Gives you MORE VALUE!

Only a Dodge truck offers these exclusive years-ahead features . . . provides so much extra worth for the low price that you pay!

NOW YOU CAN GET

the world's most powerful low-tonnage truck engine . . .

NEW 145-HP. POWER-DOME V-8

for ½- through 1-ton pick-ups, panels, and stakes

☆ Greatest power line-up

Famous Power-Dome V-8's with unique dome-shaped combustion chambers for top power and efficiency! Full line of thrifty time-proved 6's, too! 6 great engines in all—103- to 172-horsepower!

☆ Easiest handling

39° turning angle—for sharpest turning, easiest parking of any truck! Plus new gear-before-axle steering system that helps absorb road shocks, cuts driving fatigue to a minimum!

☆ Most comfortable cab

Widest, roomiest cab interior of them all—with 61¾" of hiproom, 58⅜" of shoulder-room! Deepest easy-chair seat—with 86 soft super-cushion coil springs!

☆ Best Visibility

Biggest windshield in the popular truck field—951 sq. in. in size! Most total vision area, too, with a full 2261 sq. in.! You see more from every angle in a Dodge truck!

☆ Plus biggest savings

Power-Dome V-8 design gets more miles from every gallon of regular gas, stretches your fuel dollars! And Dodge truck quality engineering saves you even more money in long life, low maintenance!

SEE YOUR DEPENDABLE DODGE TRUCK DEALER TODAY!

Added proof...

that there's a better deal for the man at the wheel . . . with new

DODGE "Job-Rated" TRUCKS

IT'S THE PORCELAIN
THAT INSULATES

...AND LAPP PORCELAIN IS YOUR GUARANTEE OF SUSPENSION INSULATOR QUALITY

Lapp is the maker of porcelain insulators and insulating components which provide *an extra margin of operating security . . . long life . . . low upkeep and maintenance.* And nowhere is the importance of "Lapp quality" porcelain (and Lapp assembly) greater than in suspension units for transmission line duty . . . The specification *"Lapp Suspension Insulators"* is low premium insurance of long trouble-free service for your lines. Lapp Insulator Co., Inc., Le Roy, N. Y.

Lapp

It's Easy to Add Feeders

ON AN ALLIS-CHALMERS UNIT SUB

When System Growth
Demands Additional Substations,
Install Allis-Chalmers Unit Subs.
They are Simple to Specify,
Time-Saving to Install and Easy to Expand
for Future Needs.

WHEN LOAD GROWTH MEANS EXPANSION . . . add substations designed to do more than just meet your immediate needs — add Allis-Chalmers Unit Substations with built-in flexibility for the future.

Then when future residential or industrial growth necessitates additional feeders, they will be easy to add. Each feeder of an Allis-Chalmers Substation is a complete unit in itself and is easy to install.

Here's How Feeders Are Added

Remove the bolted-on plates that cover the pre-cut bus and wiring openings . . . also remove the roof splice plate from the end feeder. Now bring the new feeder into position. You'll find correct alignment is easy, insured by jig-built construction. Replacing the gasketed roof-splicing plate completes mechanical connections.

Electrical connections are also simple to make. The predrilled, silver-plated bus extensions are bolted together. Easy-to-apply no-corona tape and insulating tape finish the joint. There's no compound to melt, chip, scrape, or crack. Control wiring is easy to connect because terminal blocks are grouped . . . located for ready access.

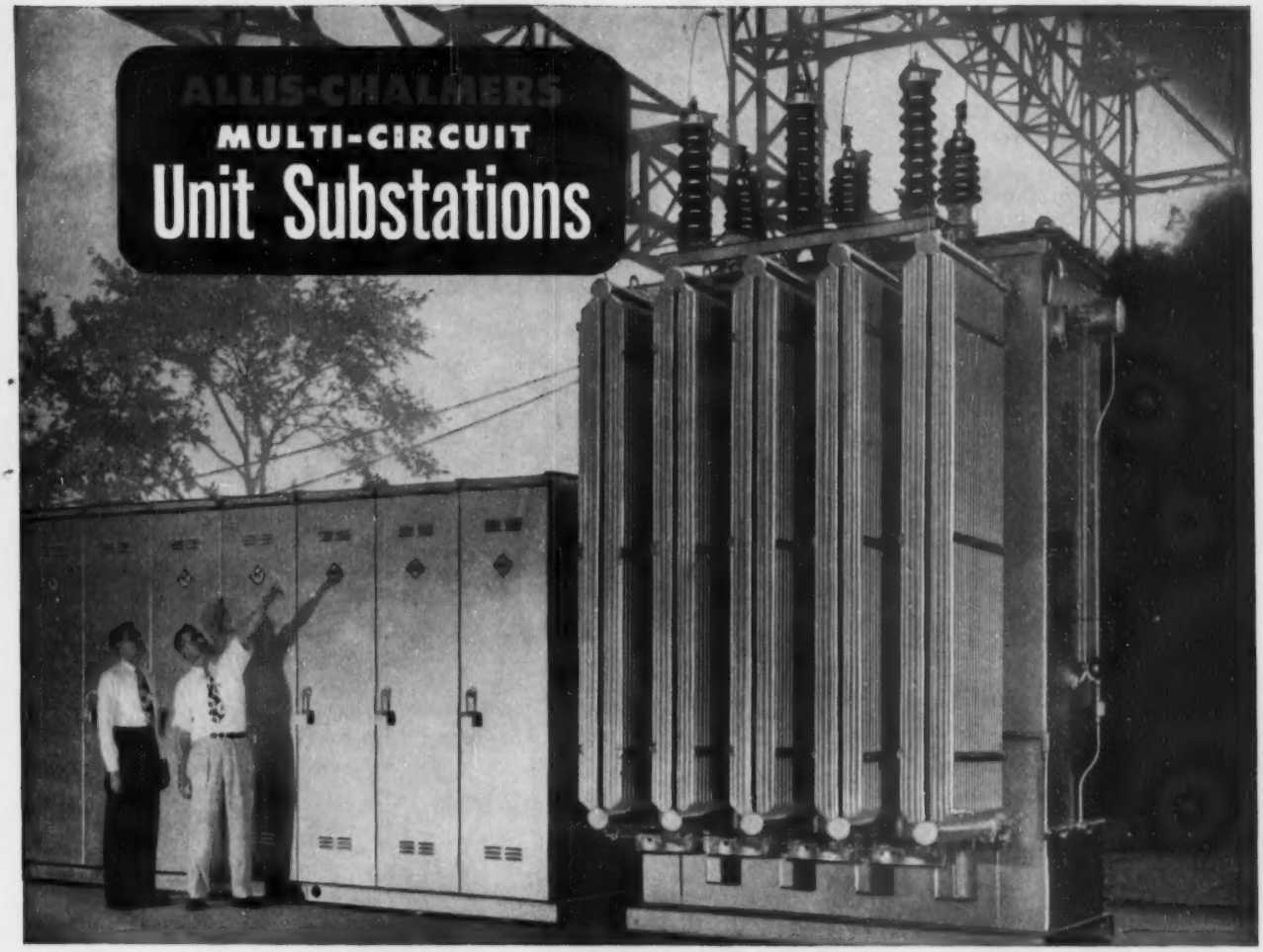
That's it! Connect feeder cables and the job is done.

MCS Unit Substations are a convenient answer to the growing distribution problem . . . to the ever increasing demand for power and yet more power. They are simple to specify, neat and modern in appearance, easy to expand, and they save you money these five ways:

(1) Original equipment cost is low; (2) compact construction reduces space requirements and real estate costs; (3) pre-wired unit design speeds installation; (4) maintenance is quick and economical because of improved accessibility, and (5) you purchase only the feeders you need *now*, deferring additional expenses until load growth demands them.

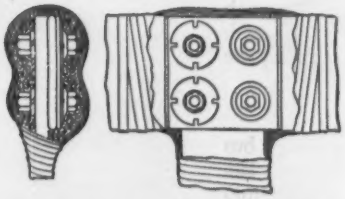
For the full story on what Allis-Chalmers Unit Substations can mean in your distribution system, call your nearby A-C representative, or write to Allis-Chalmers, Milwaukee 1, Wisconsin. A-3544

ALLIS-

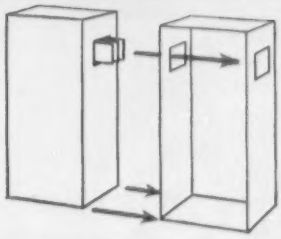


Here's Why Feeders are Easy to Add...

1 **FEEDER UNITS** are jig-built so that each feeder cubicle is exactly like every other one. Bus extension openings, control wiring openings . . . even small screw holes . . . are pre-cut in jigs. This careful, uniform construction makes field assembly easy. Just move the new feeders into position. Alignment is perfect.



2 **BUS JOINTS** are easy-to-make in the field. Bus extensions are pre-drilled and silver-plated . . . designed for quick, easy bolting together. No-corona tape covers the bolted joint . . . speeds the job by providing a smooth taping surface. Insulating tape finishes the joint. There's no compound to melt or apply.

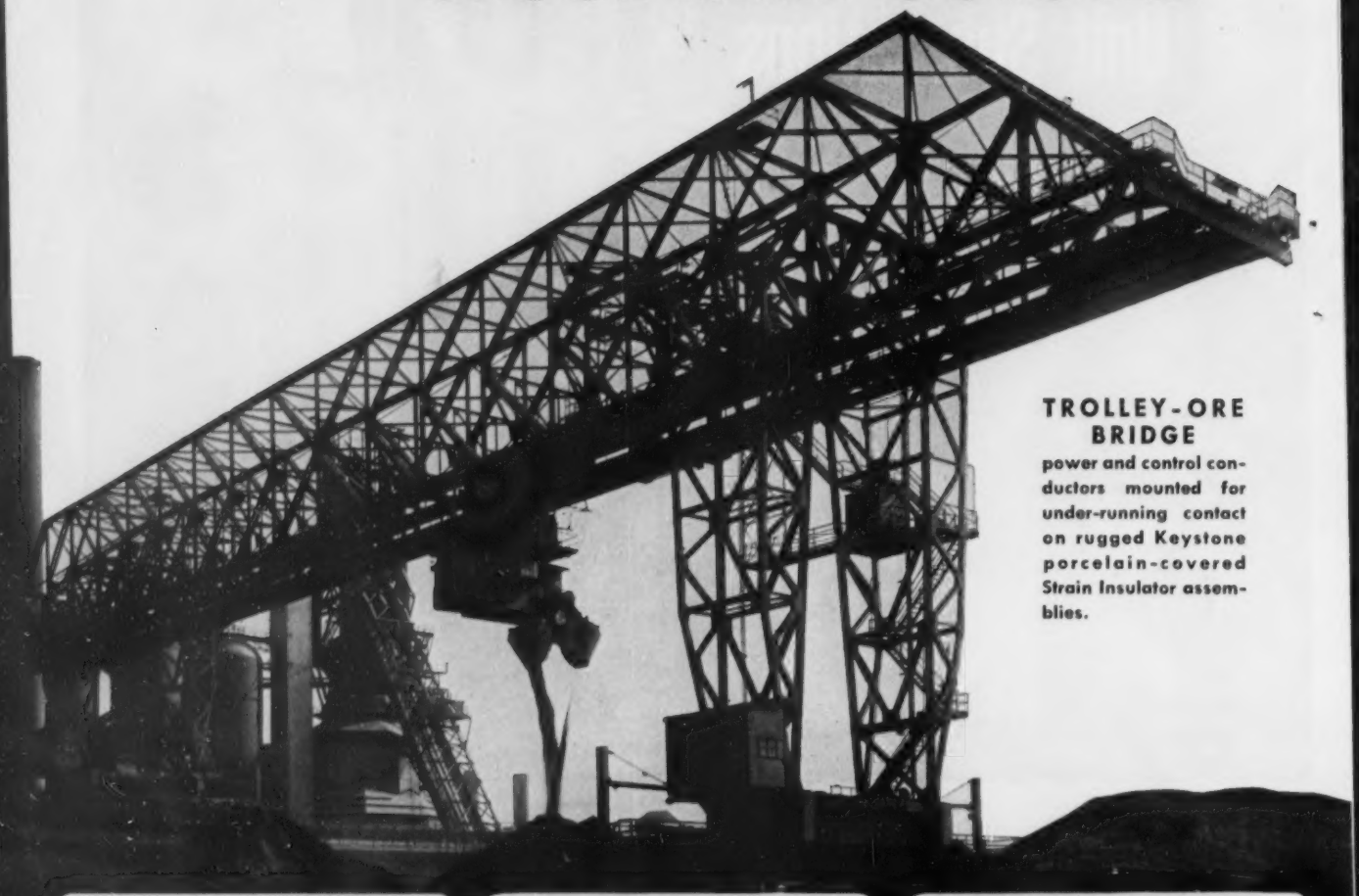


3 **EACH FEEDER** is an individual unit . . . complete with two side panels, roof and floor. All enclosed parts are protected from the weather, dust or mechanical injury even during the last minutes of installation. Gasketed roof-splicing pieces fit easily into place forming a weatherproof seal.

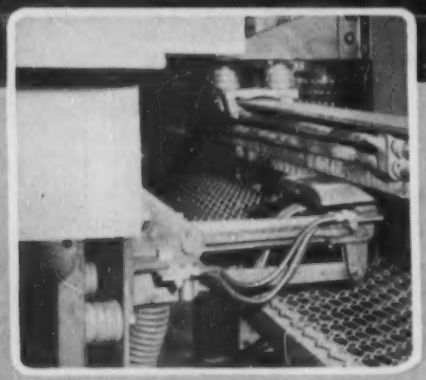
CHALMERS

A-C ALLIS-CHALMERS

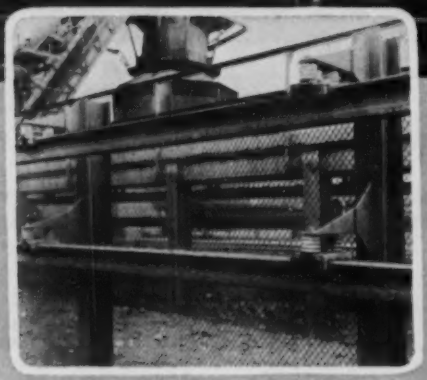
World's Newest Steel Mill Selects



TROLLEY-ORE BRIDGE
power and control conductors mounted for under-running contact on rugged Keystone porcelain-covered Strain Insulator assemblies.



RUNWAY-ORE UNLOADER
Keystone Type PS Collector heavily constructed for severe service. Both contact rails and collectors insulated with Keystone Glastic Insulators.



RUNWAY-ORE BRIDGE
equipped with Keystone Glastic Contact-rail Insulator assemblies for under-running contact-rail service.

COKE QUENCHER
Power rails equipped with Keystone wet-process porcelain petticoat-type Insulators providing long leakage distance for wet, dirty applications.

ELECTRIC SERVICE MANUFACTURING CO.,

SERVICE ENGINEERED

KEYSTONE INSULATORS

FOR UNFAILING PROTECTION

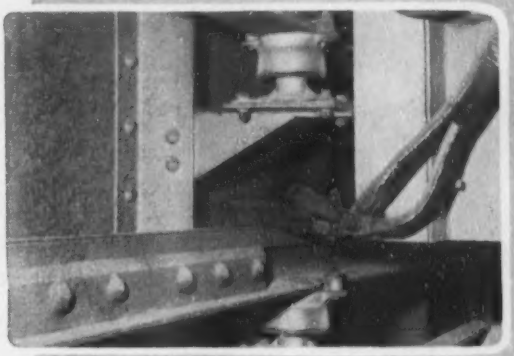
When U. S. Steel engineers built the Fairless Works to be the most modern mill in the world they had to consider every product for peak efficiency. For insulators on power lines and rails Keystone Insulators were selected and installed from the ore unloader right on through the plant.

Keystone Insulators are "service engineered" to take the toughest treatment on all installations. They have been proved and approved by years of unfailing service in the leading industrial plants throughout the world. They include:

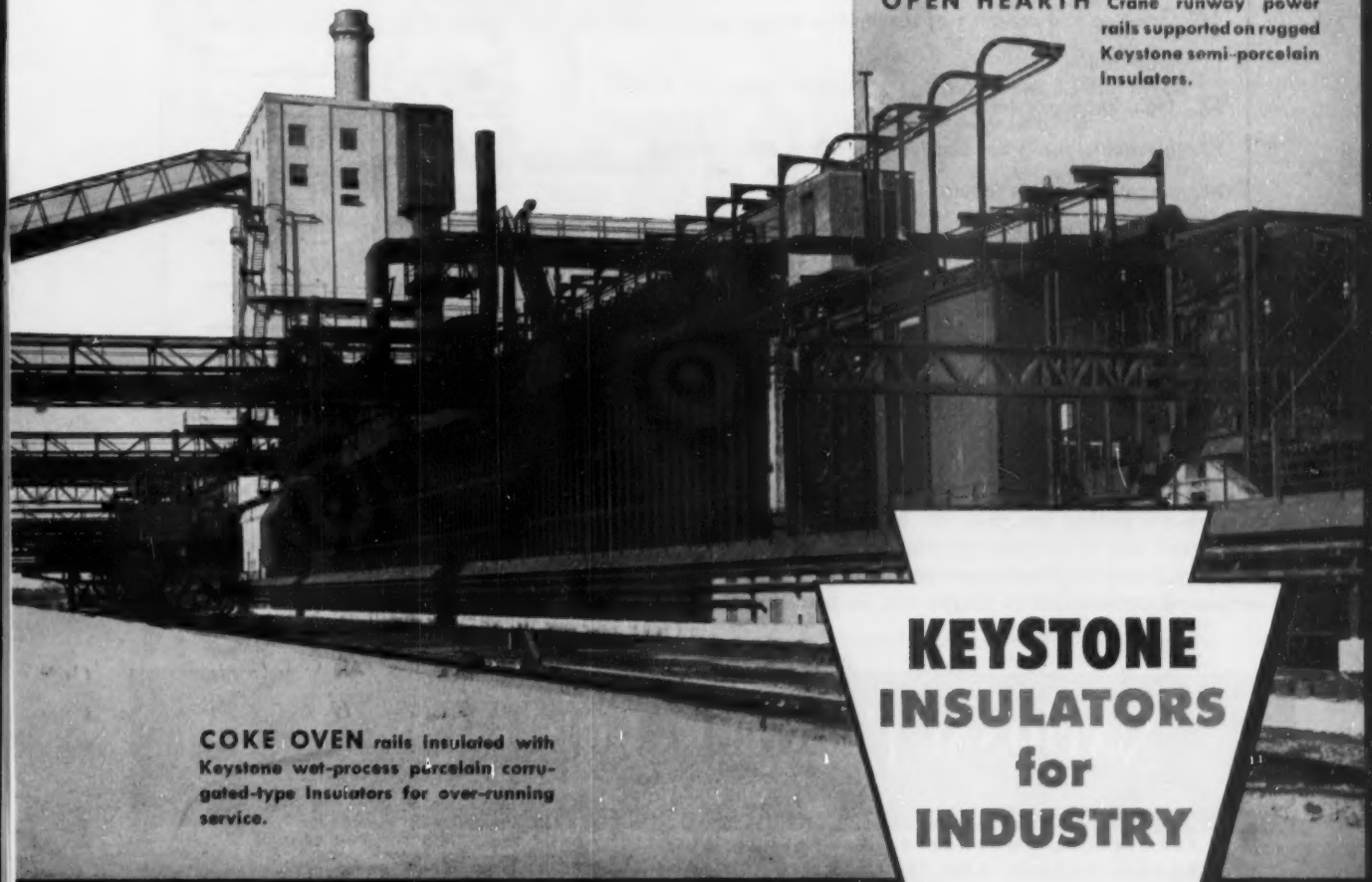
Moulded Glastic Insulators
Wet-Process Porcelain Insulators
Semi-Porcelain Insulators
Moulded Phenolic Insulators

For long, strong life and peak protection there's a Keystone Insulator that is "service engineered" to meet every need in your plant. Let ESM engineers help you select the right mechanical and electrical qualities to solve your problems. Write today for complete catalog on these Insulators, Keystone Collectors and Rail Shoes.

SOAKING PIT Crane runway power conductors equipped with Keystone semi-porcelain type Insulators with Keystone phenolic type Giant Strain Insulators providing double safety.



OPEN HEARTH Crane runway power rails supported on rugged Keystone semi-porcelain Insulators.



COKE OVEN rails insulated with Keystone wet-process porcelain corrugated-type Insulators for over-running service.

KEYSTONE INSULATORS for INDUSTRY

Philadelphia 32, Pa.

Represented in Canada by Lyman Tube and Bearings, Ltd., Montreal and Toronto

How Well Does Your Present Source Compare With National's COMPLETE Facilities For Motor and Generator Repair

Most motor repair shops can perform some of the operations listed below. Very few can handle them all. These are not routine operations, but extras which require expensive specialized equipment and experience. National service includes all 17 operations. How does your present repair source compare?

plus value operation	*available at National*	*at your present repair source*
1. redesigning and modernizing by competent engineers	yes	
2. vapor degreasing to insure good bonding of varnish	yes	
3. corncob blasting to prepare surfaces like new	yes	
4. rebuilding and remachining to standard of mechanical fits	yes	
5. temporary hotbanding to seat coils in slots	yes	
6. hot rerolling of permanent bands	yes	
7. grinding and polishing of journal shafts	yes	
8. vacuum impregnating	yes	
9. dynamic balancing	yes	
10. grinding and polishing of commutator at top operating speed	yes	
11. load testing	yes	
12. high frequency testing	yes	
13. electronic bar-to-bar and high sensitivity ductor testing	yes	
14. surge comparison testing	yes	
15. high potential ground testing	yes	
16. magniflux testing	yes	
17. anti-friction bearing inspection	yes	
Total	17	

If you can't answer "yes" for your present source on all 17 operations, you're taking unnecessary chances on getting less than the best repair work. You can't tell in advance on which jobs National equipment and National know-how will pay off in improved performance or longer life. So play it the one safe way — make National your first source for *all* motor and generator repairs.

For more details on why the motor or generator you send to National will often come back better than new, call your nearby National field engineer today. Or drop us a line for his name and address.

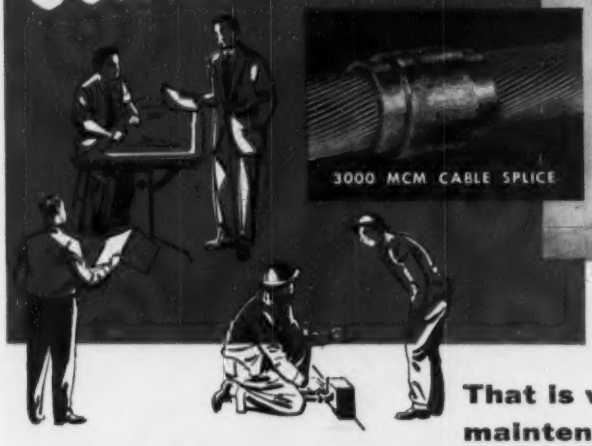
NATIONAL ELECTRIC COIL COMPANY

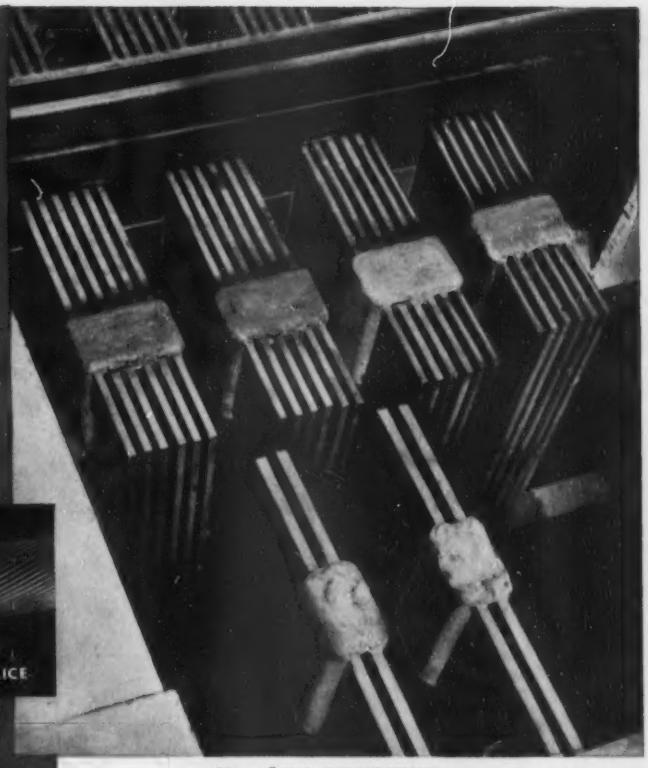
COLUMBUS 16, OHIO, U. S. A.

ELECTRICAL ENGINEERS: MAKERS OF ELECTRICAL COILS AND INSULATION
REDESIGNING AND REPAIRING OF ROTATING ELECTRICAL MACHINES

Your ELECTRICAL SYSTEM is only as efficient as its

ELECTRICAL CONNECTIONS





¼ x 4" BUS CONNECTIONS

That is why design, construction and maintenance engineers specify

CADWELD®

. . . . the fusion weld that:

- cannot loosen or corrode.
- is 100% electrically efficient.
- has small O. D. for easy insulating.
- requires no inspection.

For the best in ELECTRICAL CONNECTIONS

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2070 E. 61 St. PLACE CLEVELAND 3, OHIO

☐ Send Descriptive Literature on CADWELD Electrical Connections

☐ Have Representative Call

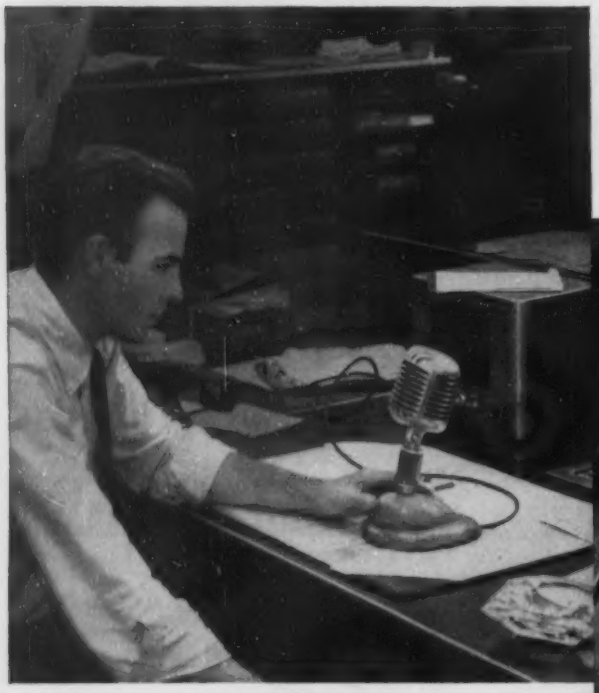
NAME POSITION

COMPANY

ADDRESS

CITY ZONE STATE

"13 YEARS' EXPERIENCE PROVES G-E BEST ON ALL COUNTS . . . performance, low maintenance and long life!"



▲ **VITAL DISPATCHING FUNCTION** that ties all service requirements into the radio network is handled at this office. Here, Jack Haley issues instructions which are acted on seconds later by maintenance crews.

FULL TIME UTILIZATION of 21 1st class troublemen and 12 trouble trucks is realized by I. P. & L. Co. Instant contact with Dave Pierson, at right, puts him "on-the-job" quickly. A total of 71 G-E radio equipped vehicles can be called into service for extreme emergencies. ▶

2-WAY MOBILE RADIO

FREQUENCY STABILITY & SELECTIVITY
guaranteed for life!

"Our complete satisfaction," says Indianapolis Power and Light Company, "is borne out by the fact that we continue to purchase G-E 2-way equipment ever since the original investment in radio was made." Since 1940 this G-E communication system has grown from 10 mobile units and one base station to 71 mobile plus 2 portable units. Wide use of these facilities enables I. P. & L. Co. to speed up all operations . . . save hundreds of man hours . . . and most important . . . to improve service in an area covering 528 square miles!

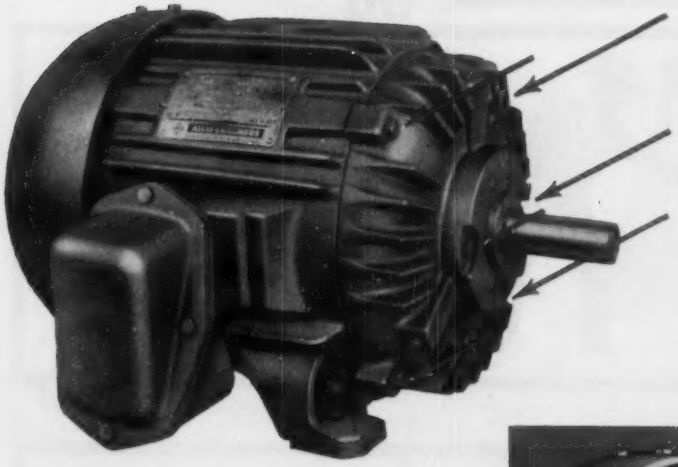
● Has your company's communications kept pace with the need for expanding utility service? Let General Electric help you answer this question. Call our local office today or write: *General Electric Company, Section X1994-6, Electronics Park, Syracuse, New York.*

Follow the trend . . . Replace with G-E!

GENERAL ELECTRIC

Here's motor superiority

you can see

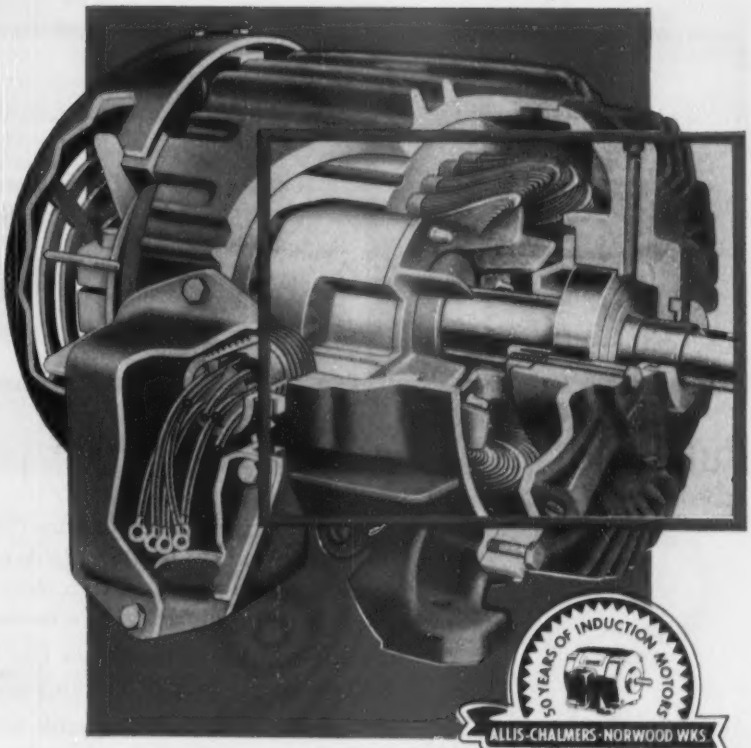


It takes 6 bolts not just 4 to give full bearing protection

THE TWO EXTRA BOLTS in the end housing of every Allis-Chalmers ball bearing motor are the proof of *extra* protection against bearing failure. These are the bolts that hold the bearing cap tightly in place against the inner face of the bearing enclosure. This cap, with its close running clearances, keeps grease from the interior of the motor . . . retains an ample supply within the bearing enclosure . . . protects the grease and the bearing against contamination from dirt and moisture.

At the outer side of the bearing, double labyrinth seals keep grease in, also keep dirt out. What's more, large grease reservoirs act as additional dirt traps.

Result? Allis-Chalmers motors pay off in longer, trouble-free bearing life, lower motor maintenance.



Get all the facts . . . judge for yourself — Compare Allis-Chalmers motors with other motors. Get the six-bolt construction that gives you complete bearing protection. For proof, see your Allis-Chalmers Office or Authorized Distributor, or write — Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

A-C ALLIS-CHALMERS

4441

FIRE!

Put it out in seconds with a Kidde portable extinguisher!

When fire strikes, there's just one thing to do – Put it out *fast!* That's why it's so vital to have Kidde portable extinguishers near every fire hazard . . . because Kidde portables, with their special fast-acting trigger release, are made to swing into action at a moment's notice.

You just grab a Kidde CO_2 or Dry Chemical portable, aim the horn, and pull the trigger. Whoof! The fire's smothered right in its tracks!

And don't forget the big hazards like motors, generators, switch gear. See that *they* get the built-in protection of a Kidde *Fully Automatic* CO_2 Fire Extinguishing *System*.

Don't wait – Contact Kidde today!

The words 'Kidde', 'Lux', 'Lux-O-Matic', 'Fyre-Freez' and the Kidde seal are trademarks of Walter Kidde & Company, Inc.

Kidde

Walter Kidde & Company, Inc., 930 Main Street, Belleville 9, N. J.
Walter Kidde & Company of Canada, Ltd., Montreal—Toronto

it's time for a new meter...

when Mrs. Steele gets her all electric kitchen

When Mrs. Steele is busy in her all-electric kitchen, she uses many convenience outlet appliances at the same time. This often proves to be too much for a meter *not built* to measure modern loads.

The new Sangamo J2 Meter is designed to measure not only today's loads but the loads of the future because it has plenty of reserve capacity . . . straight-line accuracy up to 100 amperes.

Corrosion-resistant materials and finishes, an oilless, maintenance-free bearing system and low disk speed all add up to extra long life.

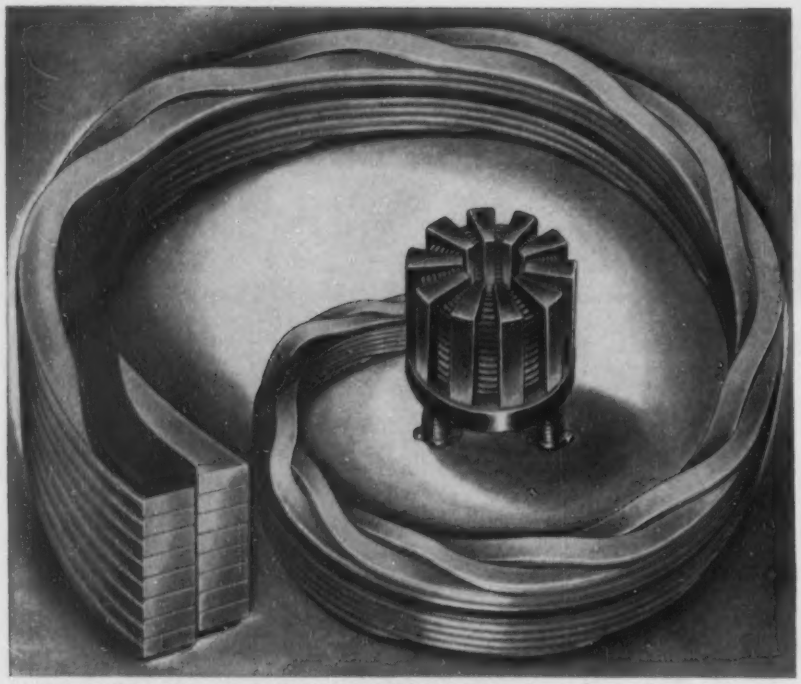
Choose the new Sangamo J2—the first . . . and finest . . . 15 ampere meter with 100 ampere capacity.

A METER WITH STRAIGHT LINE ACCURACY

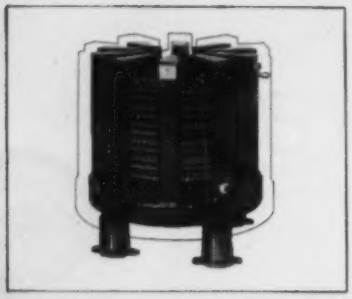
UP TO 100 AMPERES

SANGAMO
ELECTRIC COMPANY
SPRINGFIELD, ILLINOIS

JM54-9



CONTINUALLY TRANSPOSED RECTANGULAR CONDUCTORS—shown here schematically—are made possible by a specially designed machine. This exclusive G-E reactor feature results in more uniform current distribution and lower power losses.



COMPACTNESS Transposed conductors decrease volume up to 20%. You can fit G-E reactors in vaults too small for others.

ECONOMY By choosing G-E reactors with aluminum conductors you can save 10% on price without any sacrifice in reactor quality.

Compare . . . and you'll choose G-E Reactors

"Extra service" features of G-E cast-in-concrete reactors mean maximum protection and longer service life.

Industry's favorite for more than 35 years, G-E cast-in-concrete reactors offer you "extra service" features that make possible almost unlimited life with virtually no maintenance. For example:

Continually transposed conductor, an exclusive G-E feature, assures more uniform current distribution . . . lower losses . . . smaller dimensions.

Non-aging glass insulation gives greater short-circuit protection than any other wound insulation used in reactor manufacture . . . does not deteriorate even under high overloads . . . remains unaffected by moisture.

Wet steam curing of concrete assures full strength at shipment . . . eliminates potentially dangerous "in service" curing.

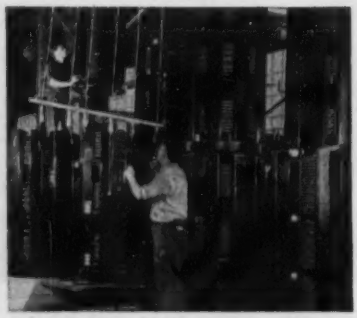
You also get such features as: good clearances; crossovers made within concrete; smooth, flameproof black phenolic varnish finish; and metal housings, complete with entrance and exit provisions, to minimize stray currents and protect reactors from damage.

And you can have a 10% price reduction!

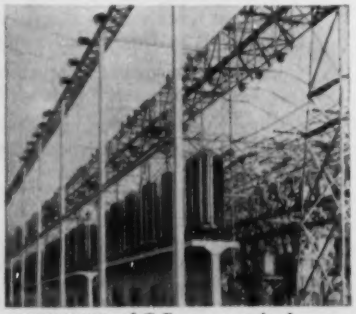
You can buy sturdy, dependable G-E cast-in-concrete reactors with either copper or aluminum conductors. By choosing aluminum conductors you can get the same long life, high short-circuit strength and low maintenance obtainable with copper conductors . . . at a 10% price reduction.

For full information contact your nearest G-E Apparatus Sales Office or write to General Electric Company, Section 422-8, Schenectady 5, New York.

GENERAL ELECTRIC



AVAILABILITY You can get shorter shipments when you order RM reactors thanks to G.E.'s "repetitive manufacture" program.



DURABILITY of G-E reactors is dramatized by this 30-year-old installation. It has given no trouble, needed little maintenance.

BEFORE YOU BREAK GROUND

Construction of a new plant starts when the steam shovel takes its first bite of earth. But the actual building process begins *before* you break ground.

It begins when the need for new plant facilities is recognized and engineers are called into action. Then it develops on the drawing board—through plant layouts, working drawings, engineering specifications. It requires consideration of engineering and production techniques—analysis of all factors that must be taken into account before construction can start.

Ebasco skilled engineers and constructors have experience in every phase of the building process—from preliminary planning right up to a plant's successful operation. This experience has enabled Ebasco to complete more than two billion dollars' worth of new plant design and construction for many industries, in many parts of the world.

The engineering and construction firm you select to design and build your plant may well hold the key to its future success. If *you* are considering such a project, send for our booklet, "The Inside Story of Outside Help." It describes our engineering and construction services as well as the wide range of consulting services Ebasco offers business and industry. Write: Ebasco Services Incorporated, Two Rector Street, New York 6, N. Y.

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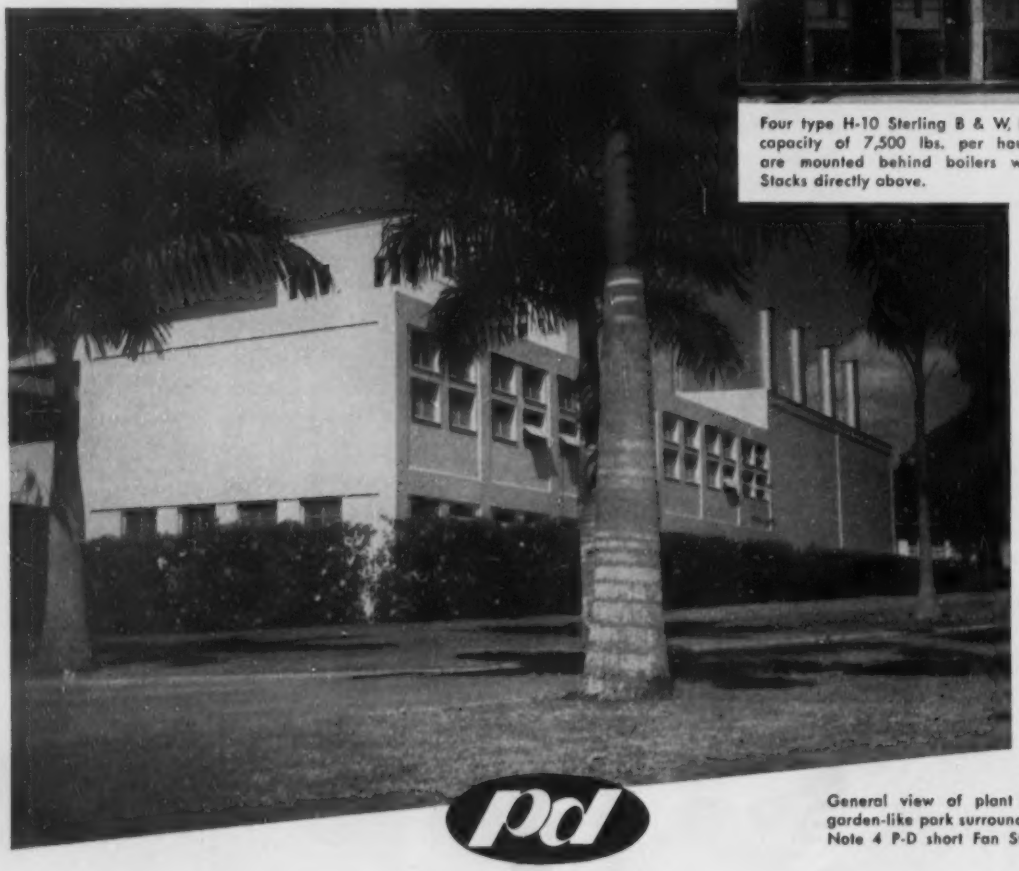
Garden spot for **power...**

Four type H-10 Sterling B & W Boilers with steam capacity of 7,500 lbs. per hour. P-D Collectors are mounted behind boilers with the P-D Fan Stacks directly above.



General view of plant from garden-like park surroundings. Note 4 P-D short Fan Stacks.

...kept free from flyash with P-D Dust Collectors

A model power plant, set in a garden, was realized by Cerveceria Modelo, S.A., Cotorro, Cuba. This company, a part of the Bacardi interests, determined to maintain a garden-like atmosphere surrounding the plant.

Although boilers are completely automatic, Prat-Daniel design 6HC horizontal Dust Collectors were installed to collect flue gas residue resulting from oil-firing. P-D Fan Stacks insured adequate, constant draft through boiler and collectors. Capacity of these collectors at 580°F. is 4860 CFM at 1.75 in WG resistance.

Your plant can enjoy garden-like surroundings, kept free of dust, with P-D Collectors. Why not contact our project engineer today?

Project Engineers

THE THERMIX CORPORATION

GREENWICH, CONN.

(Offices in 38 Principal Cities)

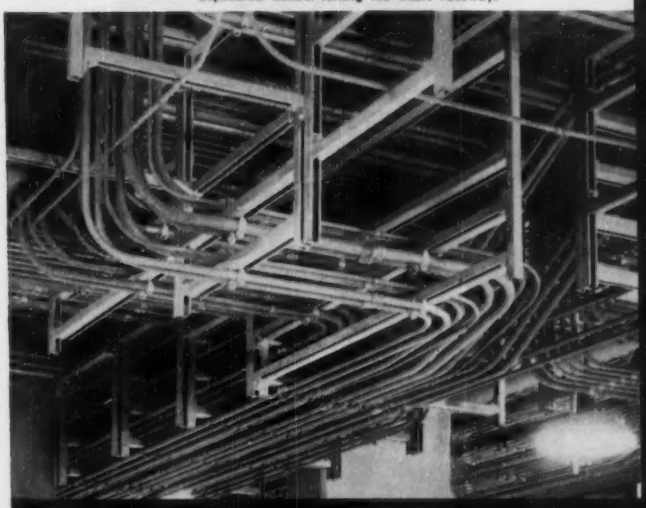
Designers and Manufacturers *Canadian Affiliates:* T. C. CHOWN, LTD., Montreal 25, Quebec; Toronto 5, Ontario PDC 154.1

PRAT-DANIEL CORPORATION

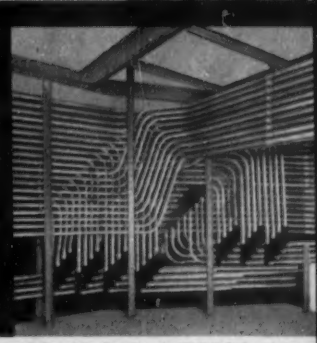
SOUTH NORWALK, CONN.

POWER DIVISION: Tubular Dust Collectors, Forced Draft Fans, Air Preheaters, Induced Draft Fans, Fan Stacks

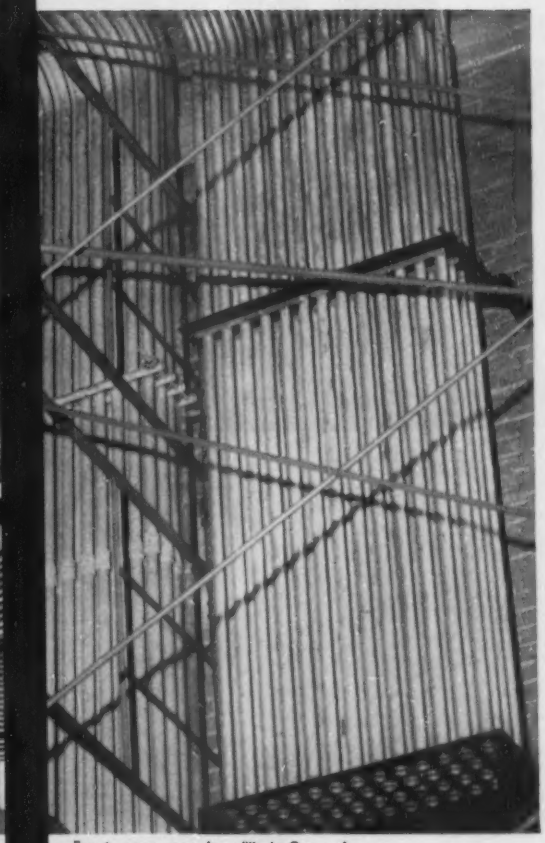
Industrial power plants, too, recognize the advantages of Republic E.M.T. This is at Kaiser Aluminum & Chemical Corp.'s new Chalmette, La., plant. Notice the close, intricate runs which were easily duplicated without turning the whole raceway.



No lines to turn, no threading with Republic "Inch-Marked" E.M.T. It's also easier to install runs in cramped spaces, even where there are multiple runs. New substation is part of Cleveland Electric Illuminating Co.'s continuing expansion program.



Republic "Inch-Marked" E.M.T. has been on the job in this mid-West utility more than 16 years. Original installation saved a ton of weight per thousand feet, resulted in lower building costs.



Twenty years ago, Iowa-Illinois Gas and Electric Co. put some wiring in Republic E.M.T. It's still on the job. Wiring in the company's new 69kv substation at the Moline Generating plant is also in Republic E.M.T.

Let's talk about your plans for 1974

Specifically, the electrical raceways which will go into your present plans for expansion.

You'll want the most modern steel raceway, one that's a good investment. You'll want one that's lightweight. That means easy handling, easy installation. It also means lighter supporting members for the building, lower construction costs.

Republic "Inch-Marked" E.M.T. is the electrical raceway which can give you all these advantages. It gives the strength of steel plus the protection of a galvanized coating that won't flake, chip or peel. It's manufactured from ductile, high quality steel made by Republic Steel Corporation, producer of the widest range of steels and steel products.

Before your staff decides on electrical raceways, make sure they look into Republic "Inch-Marked" E.M.T. Booklet SA-54 or Sweet's Catalog will give you all the facts. And so will a Steel and Tubes salesman. Just phone your nearest Republic District Office.

REPUBLIC STEEL CORPORATION
Steel and Tubes Division
213 E. 131st Street, Cleveland 8, Ohio
GENERAL OFFICES • CLEVELAND 1, OHIO
Export Department: Chrysler Building, New York 17, New York

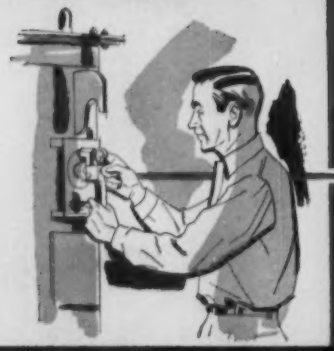
REPUBLIC
ELECTRUNITE E.M.T.

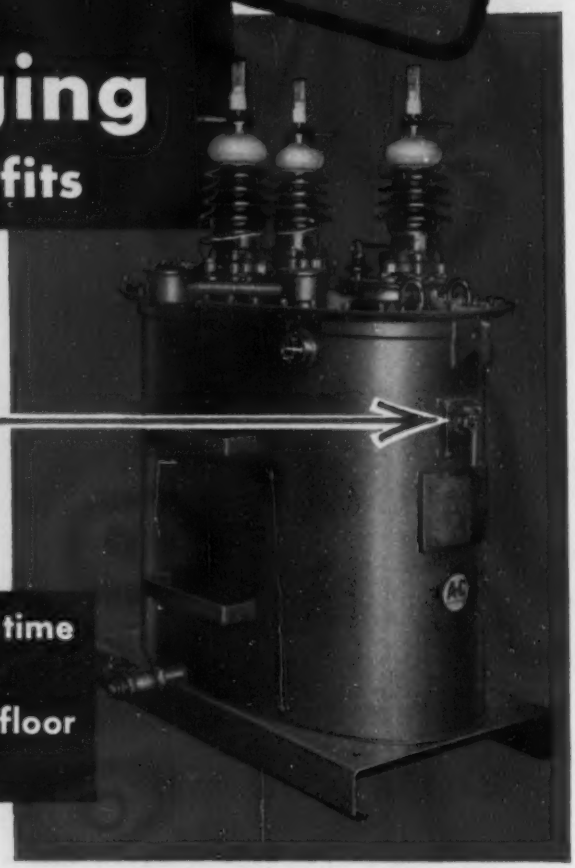
Now—

External Ratio Changing

For Metering Outfits

ALLIS-CHALMERS
Instrument Transformers





- FASTER — reduces time for ratio changing
- SAFER — permits floor level operation

External ratio changing is now standard on Allis-Chalmers metering outfits for current ratings up through 200/400 amp, 25 kv through 69 kv. Consult factory for ratio changer on 15-kv metering outfits.

NOW Allis-Chalmers gives you *external* ratio changing on metering outfits. A real convenience — just de-energize the circuit and rotate the handle. All phases are changed simultaneously. The ratio changer used is the same rugged "point contact" mechanism already proved in service on Allis-Chalmers power transformers.

Ratio Changer Features

Contacts are self-aligning. Contact pressure is equal and positive; it is increased as a result of magnetic forces. A single current path is established by round point contact under high unit pressure against a flat stationary contact. Strong wiping action cleans surfaces for good contact.

Get Complete Information

Find out how Allis-Chalmers metering outfits with *external* ratio changing for de-energized operation give you faster, safer, simpler operation. Call the A-C office nearest you, or write Allis-Chalmers, Milwaukee 1, Wis.

A-4359

You get high safety factor and sound electrical design in Allis-Chalmers metering outfits. Insulation life is extended because corona is minimized — one more step toward longer service life. All metering outfits are furnished with double current ratings to provide for future load growth.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

Carrying coal in Delaware Valley with U.S. Rubber Conveyor Belts

(at right) U. S. Giant® Conveyor Belt, carrying coal from car dumper to breaker house.

Panoramic view of part of conveyor belt system utilizing U. S. Giant Conveyor Belting in power plant on the Delaware River.

To feed the four boilers in this power plant in the Delaware Valley, United States Rubber Company conveyor belts, capable of handling 300 tons of coal an hour, take the coal from hopper cars to breaker house to coal bunkers. Like so many other successful belting installations, this one is the result of United States Rubber Company's "Three-Way Engineering" —in which "U.S." engineers work with the engineers of the conveyor system and the power company engineers to turn out the most durable, economical belt system for the specific job. In America and abroad there are thousands of "Three-Way Engineered" jobs, some large, some small —but all steadily keeping output high, costs low. Get in touch with any of the 27 "U.S." District Sales Offices, or write address below.

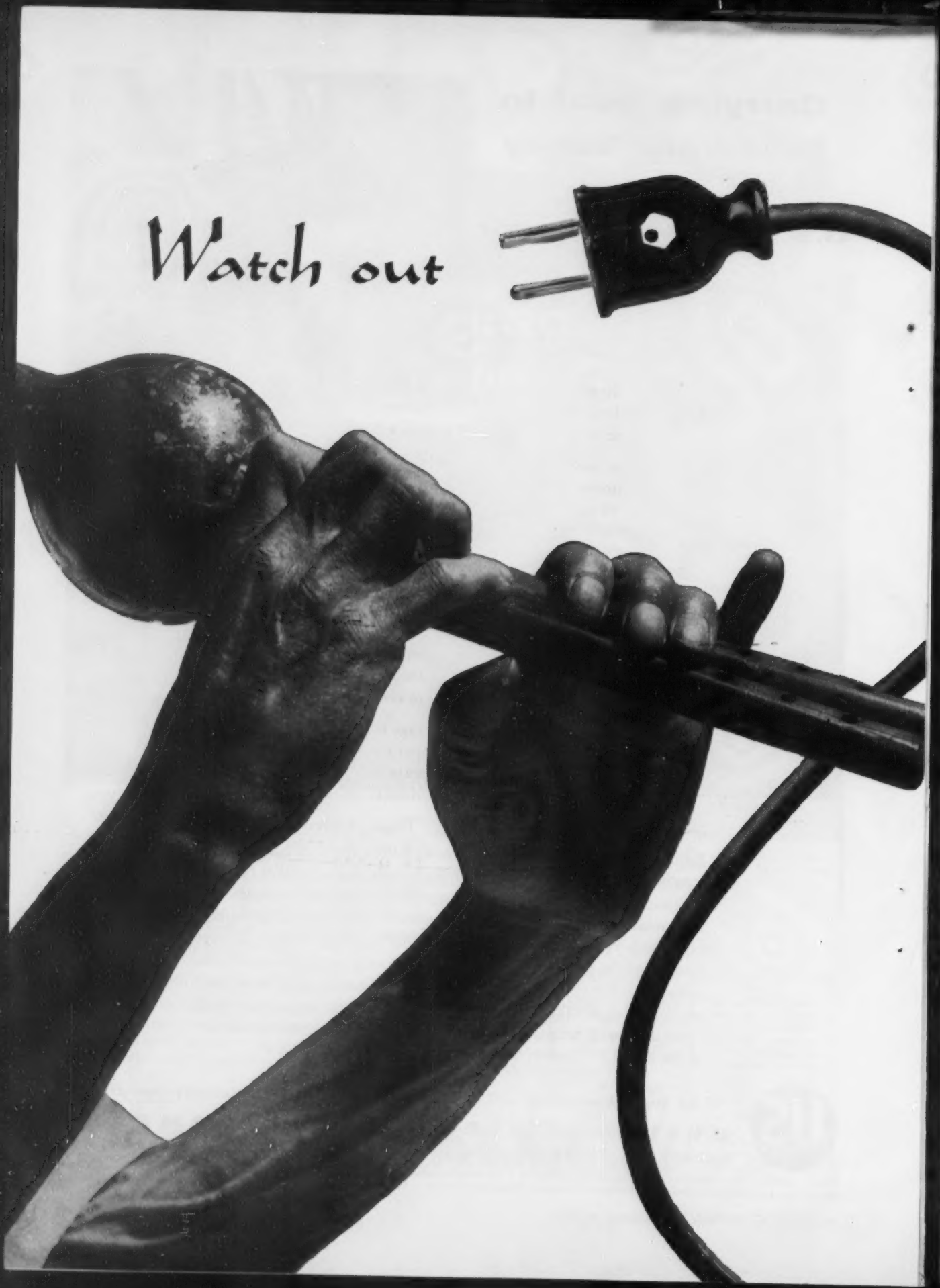
US RUBBER

"U.S." Research perfects it... "U.S." Production builds it... U.S. Industry depends on it

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION • ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting


Watch out

when the music stops!

This isn't the only wire leading a charmed life. There are others in over 40,000,000 buildings in this country—in business establishments as well as homes. Maybe one of them is in *your* home. We hope not—but could be.

Let's say that you and your wife are entertaining the boss and his spouse. You've passed around the cocktails, you're all sitting back relaxed. Four pairs of enraptured ears are absorbing Beethoven from the Hi-Fi. Suddenly—poof—nothing!

Brother, you've had it. Or, rather, your circuit's had it. You'd be tired out and burned up, too, if you had to carry more than your share of the load. You've just caught the backfire from inadequate wiring.

Did you ever stop and think how many conveniences in your home these days are electrical? Range, vacuum, toaster, power tools, washer, clothes dryer, radio, TV, air-conditioner, fans, coffee maker, freezer—well, why go on. You get the picture. And there are more electrical wonders to come.

The number of appliances in use in the average home has increased four-fold in the last 25 years. The average home, apartment or office building when built was wired for only a 20 or 30% increase in electric load. Can you see why 4 out of 5 buildings are inadequately wired today?

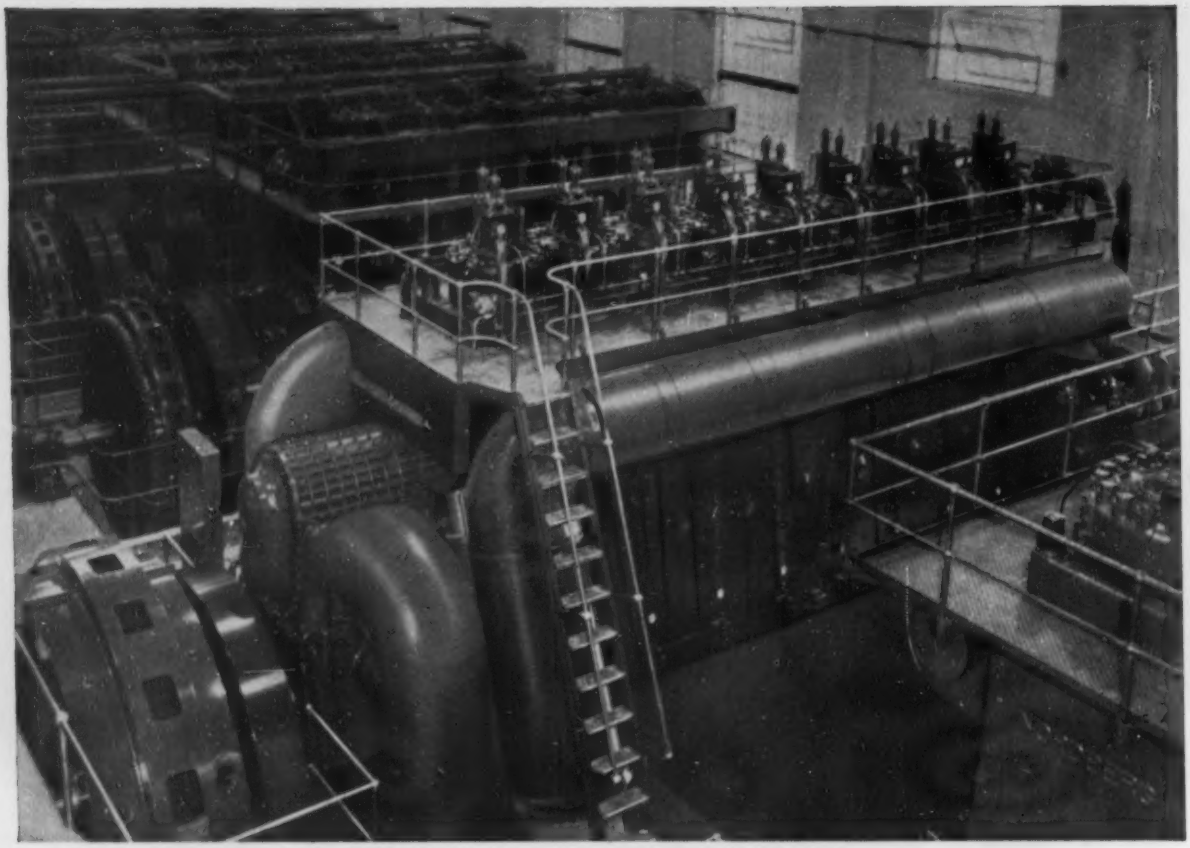
How's your house? Or place of business? Think it's adequately wired? Be sure—talk with your local electric light and power company . . . get their counsel. They don't have anything to do with the wiring *inside* your home but they do handle the power that goes into it. They want you to get the most out of it. Or, if you'd prefer, write us for your free copy of "Getting The Most From Your Home's Electrical System."

This message is the fourth in a series currently appearing in magazines reaching more than a million readers — businessmen and homeowners. It is sponsored by Electrical World for the most unselfish-selfish reason—what is good for the electric power industry is good for the publication that has served it continuously for 80 years.

Electrical World

AW ADEQUATE WIRING SERVES AND SAVES

A McGRAW-HILL PUBLICATION, 330 WEST 42ND STREET, NEW YORK 36, N. Y. • ABC • ABP



Largest Diesel Power Generating Station in the U.S.

reduces cylinder and piston ring wear with SHELL ROTELLA OIL

Electric power for the City of Grand Haven, Michigan, and the surrounding area, is generated by diesel engines in the largest municipal power station of its kind in the U. S. A. Shell Rotella Oil is the cylinder lubricant.

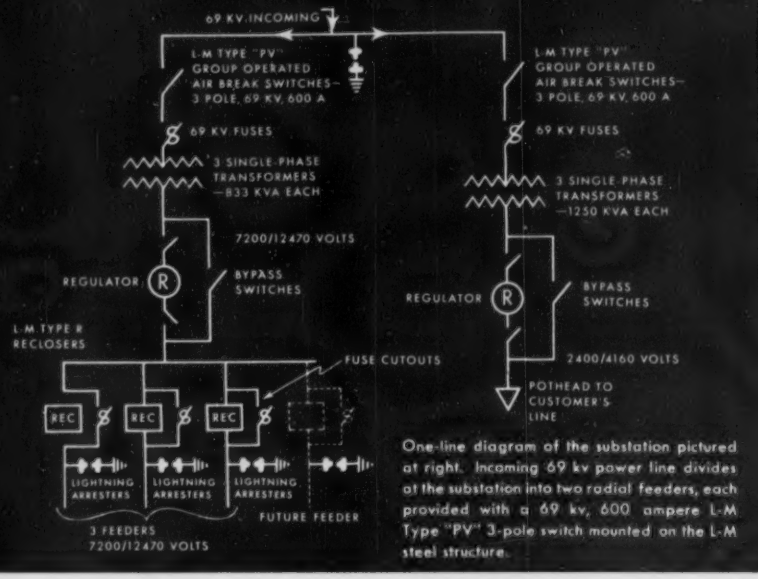
The anti-corrosive action in Shell Rotella Oil combats the major cause of engine wear . . . cylinder and piston ring wear caused by acid action from the by-products of incomplete combustion and condensation.

Tougher lubricating film in Shell Rotella Oil gives cylinders and rings greater protection . . . minimizes wear. Its effective detergent-dispersant action prevents harmful deposits.

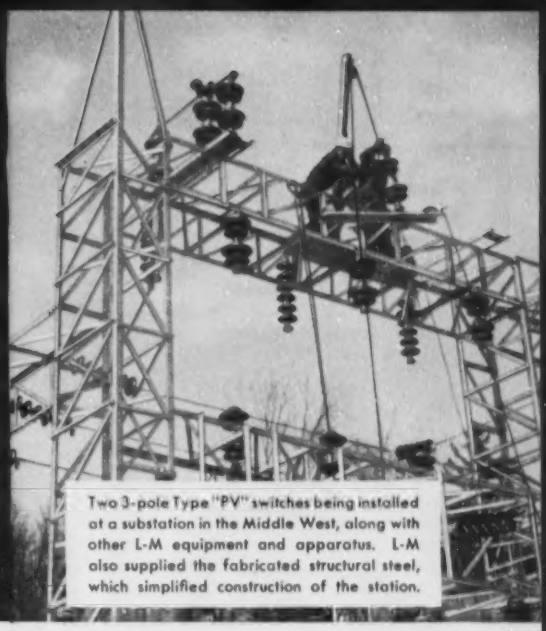
Write for technical information. See for yourself how Shell Rotella Oil can help reduce your engine maintenance costs.

SHELL OIL COMPANY
50 WEST 50TH STREET, NEW YORK 20, NEW YORK
100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL



One-line diagram of the substation pictured at right. Incoming 69 kv power line divides at the substation into two radial feeders, each provided with a 69 kv, 600 ampere L-M Type "PV" 3-pole switch mounted on the L-M steel structure.



Two 3-pole Type "PV" switches being installed at a substation in the Middle West, along with other L-M equipment and apparatus. L-M also supplied the fabricated structural steel, which simplified construction of the station.

Powerful Lever Advantage Assures Positive Operation of L-M's "PV" Air Break Switches

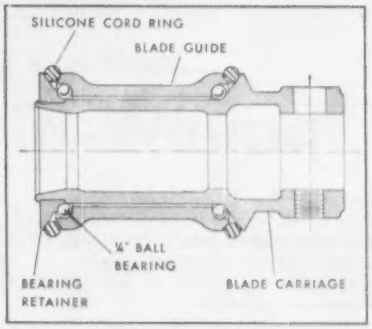
New rotating switch blade concept in switch design provides powerful lever advantage, assures positive operation to open or closed switch position regardless of ice, corrosion, or long periods of non-operation.

The primary function of the air break switch is to provide a means of connecting or disconnecting transmission and distribution circuits. In addition it must meet all of the other requirements for a good switch—ease of operation, convenience and simplicity of installation, high current-carrying capacity, high contact pressure without undue wear.

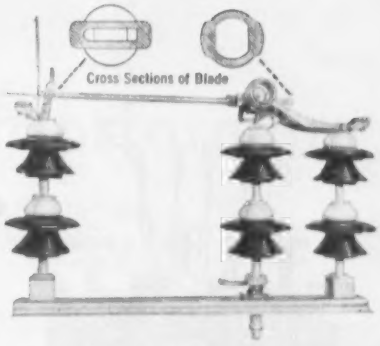
We have amply met these requirements in our Type "PV" Rotating Insulator, Vertical Break, Air Switch. Some of the outstanding features are: silver-to-silver high-pressure contacts; new contact design, with contact pressure easily adjusted in the field; ball bearings lubricated for life with silicone grease and sealed with silicone cord rings; only 6 current interchange points in the entire switch; flexible interphase mechanism assembly, permitting angular distortion of mounting structures.

These switches are for both pole and structure mounting in horizontal, vertical, or inverted position. The interphase assembly, connected direct or indirect, transmits power to the switch mechanism with minimum of lost motion. Every joint of the interphase assembly is lubricated with silicone grease and sealed with a silicone cord ring. Ratings are from 7.5 through 69 kv in 400 and 600 amperes continuous current-carrying capacity. Available with or without horn gaps, from one- to six-pole units.

For complete information on L-M Type "PV" Switches ask the Field Engineer for a copy of Bulletin PSE1 and PSE2, or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).



Smooth, Easy Operation—The method of sealing a bearing or a joint is shown in sketch above. All the bearing locations or joint locations involved in movement and transmission of power from the operating mechanism to the switch blade itself are protected from corrosion with silicone lubricant sealed in by silicone cord rings.



L-M's new 69 kv Type "PV" switch, above, has major castings of high-grade aluminum bronze alloy, which makes them exceptionally strong, permits lighter cross sections, and is virtually free from corrosion.

New Switch Design Assures Positive Operation

Drawings show blade rotation and rise between the jaw contacts.

1. Normal closed position—blade between contacts and locked in position by the action of the link and crank assembly.

2. Start of opening motion. The blade twists 26 degrees before rising, with all the force applied at the operating handle being imparted to this twisting action, thus assuring positive breaking of any ice or corrosion.

3. The blade is now starting to rise. It has rotated 40 degrees with only a 3 degree rise. Also note how blade rotation has moved the silver inserts away from the silver inserts in the contact shoes, minimizing wear.

4. With approximately 37 degrees crank rotation, the blade has been rotated a full 48 degrees, but has risen only 6 degrees.

5. Blade has risen 9 degrees with a 56 degree blade rotation. On closing the switch, the reverse motion provides the most effective possible ice-breaking action if the switch should be iced open.

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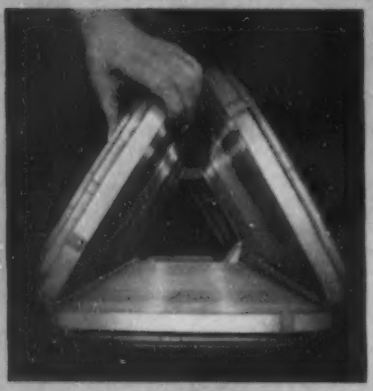
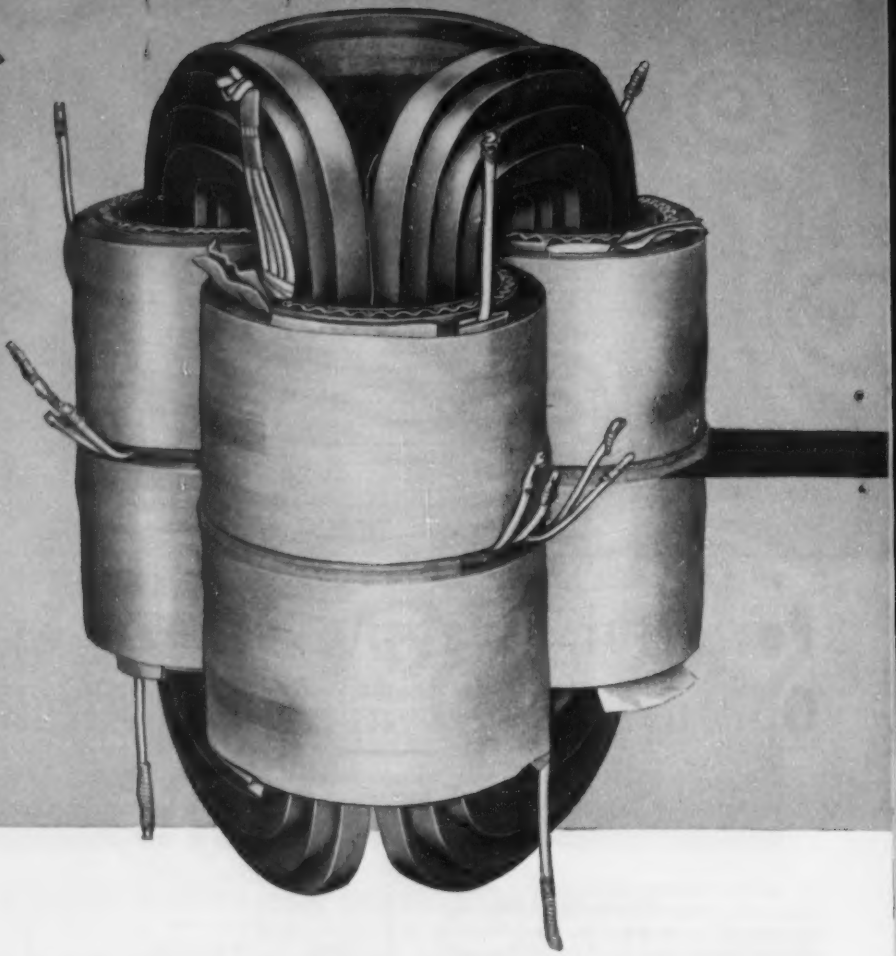
LINE MATERIAL *Power Switching Equipment*

The L-M Tri-Wound core-coil configuration results in a compact and highly efficient structure. The inherent characteristics of the continuously wound core and the round coils offer distinct design and operating advantages.



The core structure consists of three continuously wound cores of oriented-grain silicon steel strip assembled into a balanced magnetic unit.



The new Tri-Wound is built to resist short-circuit forces. Note the strong steel frame and heavy clamping bolts. Sturdy maple blocks at top and bottom are tightened and clamped against the coil ends to prevent axial movement.

Completed Tri-Wound 3-phase transformer. The unit is smaller and lighter than L-M's previous type. The transformer provides all the well-known advantages of L-M's single-phase Round-Wound transformers.

Outstanding Characteristics of L-M Tri-Wound Transformers

High short-time overload capacity

Good regulation at all power factors

High impulse level with ample creepage distance and generous insulation

High short-circuit strength

Filled with ORTO®, L-M's oxidation-resistant transformer oil, inhibited for longer life

Available in sizes 9, 15, 30, 45, and 75 kva

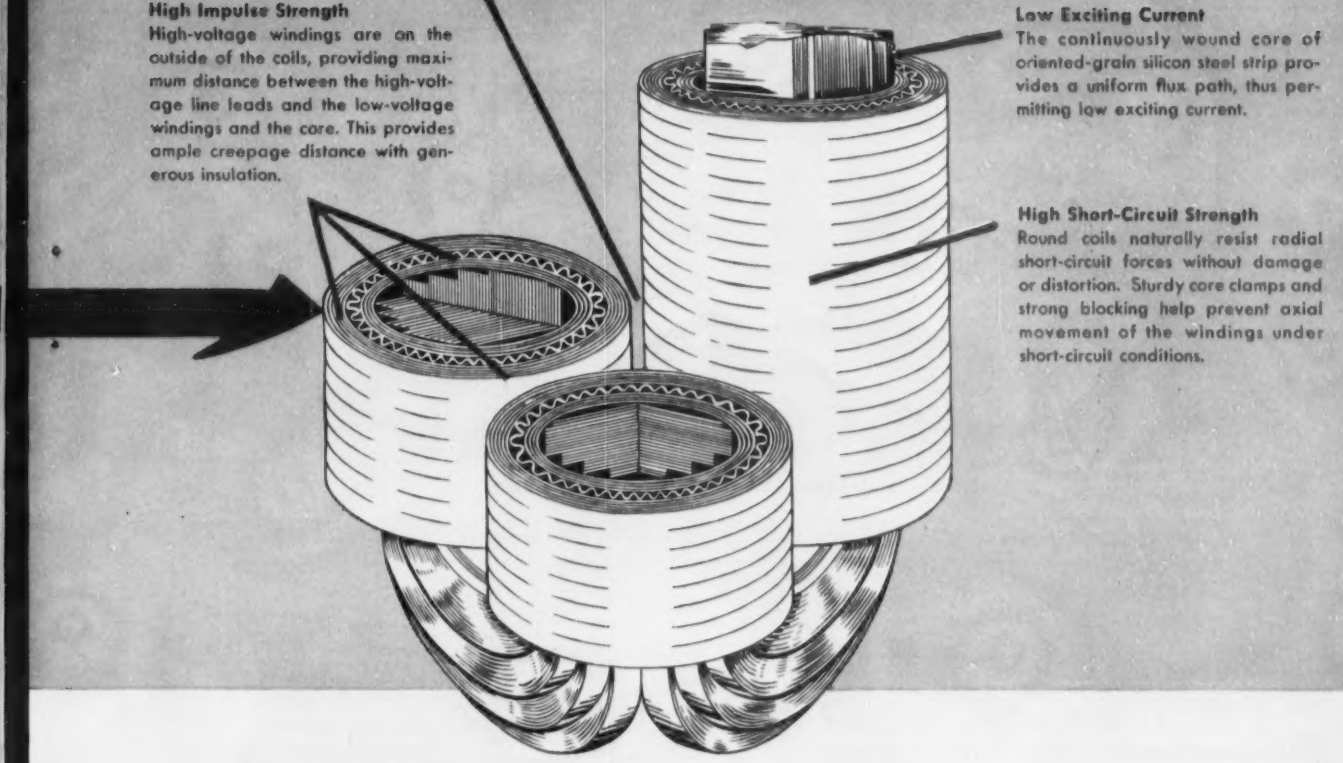
"Tri-Wound" and "Uni-Wound" are Line Material Company trade-marks.

High Short-Time Overload Capacity
Core clamps are designed to provide a chimney effect between the three coils. This chimney effect plus the exposed outer coil surfaces provides effective cooling. Oil ducts, located throughout the coil, contribute to uniform, efficient cooling.

High Impulse Strength
High-voltage windings are on the outside of the coils, providing maximum distance between the high-voltage line leads and the low-voltage windings and the core. This provides ample creepage distance with generous insulation.

Low Exciting Current
The continuously wound core of oriented-grain silicon steel strip provides a uniform flux path, thus permitting low exciting current.

High Short-Circuit Strength
Round coils naturally resist radial short-circuit forces without damage or distortion. Sturdy core clamps and strong blocking help prevent axial movement of the windings under short-circuit conditions.



For 3-Phase In 9 To 75 kva Sizes...

L-M's New Tri-Wound™ Transformers

Apply Round-Wound® principles to 3-phase construction to provide light weight and small size, high overload capacity, high short-circuit strength, high impulse strength.

By **JAMES G. EVERHART**
Chief Engineer
Transformer Division
Line Material Company

L-M's new *Tri-Wound* fills the need for a smaller, lighter 3-phase transformer that utilizes the full advantages of a continuously wound magnetic core and round coils. This new Tri-Wound transformer is now available in sizes 9 through 75 kva and in all voltage classes through 13,800 volts.

L-M's larger-sized 3-phase transformers are the new *Uni-Wound*, which provide Round-Wound's balanced performance in sizes from 112½ through 500 kva.

Continuously Wound Core

The Tri-Wound transformer consists of three cores, continuously wound of oriented-grain silicon steel strip. The bare cores are annealed after fabrication, and placed as shown in the illustration. Then round coils are wound directly onto the three core legs by L-M's exclusive winding process.

Tri-Wound is Smaller and Lighter

Integrating the core-coil assemblies into one unit provides a substantially lighter, smaller 3-phase transformer. For example, the 75 kva Tri-Wound is approximately 250 pounds lighter than previous designs. In addition, the over-all height of this new Tri-Wound unit has been reduced about 1½ feet, with very little increase in the projected floor space.

Balanced Performance

Performance characteristics of the Tri-Wound transformer have been coordinated to give good over-all balanced operation, with each characteristic being considered in its relationship to the over-all performance of the transformer.

Get Details of Tri-Wound Transformers

Ask the L-M Field Engineer to give you full details; or write Line Material Company, Transformer Division, Zanesville, Ohio. (Line Material Company is a McGraw Electric Company Division.)

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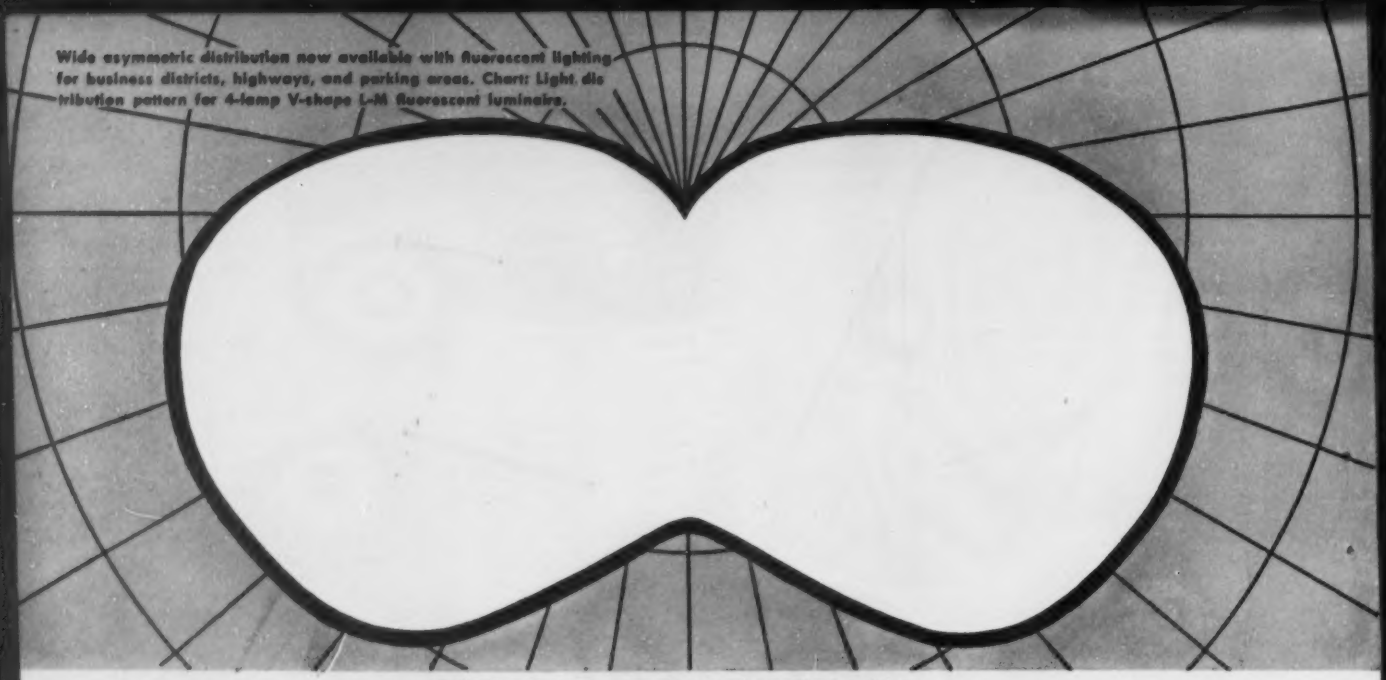
LINE MATERIAL Transformers



Wide asymmetric distribution now available with fluorescent lighting for business districts, highways, and parking areas. Chart: Light distribution pattern for 4-lamp V-shape L-M fluorescent luminaire.

L-M Fluorescent Luminaire Installation Data

Average foot candles at 50° F. temp. in still air—25' mounting height. Illustrations below show L-M's various types of units and mountings, together with the average foot candles on the street with various spacings.

4-lamp V-shape fluorescent luminaire provides more even light distribution for wide streets.

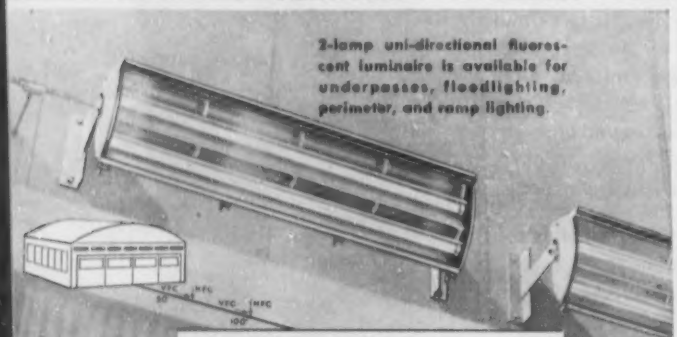
4-Lamp V-shape Fluorescent Luminaire*

Spacing	Staggered 50' Street Width	Opposite 70' Street Width
75 ft.	1.75 A.F.C.	—
100	1.30	2.15 A.F.C.
125	1.05	1.90
150	0.85	1.45
175	—	1.25

4-lamp bi-directional fluorescent luminaire provides a broader light pattern for center parkway and area lighting.

4-Lamp Horizontal-mounted Fluorescent Luminaire*

Spacing	Center-Mounted Twin Arm 40' Road Twin Roadways	Staggered 50' Street Width	Opposite 70' Street Width
75 ft.	2.85 A.F.C.	1.35 A.F.C.	—
100	2.15	1.00	1.55 A.F.C.
125	1.70	0.80	1.26
150	1.40	0.65	1.05
175	1.20	—	0.90

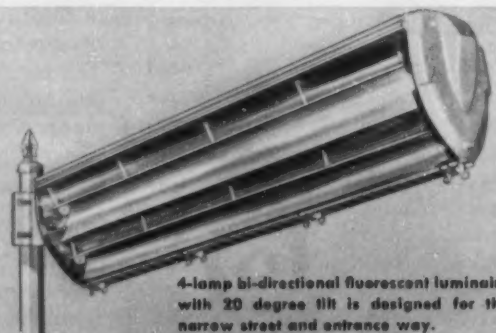


2-lamp uni-directional fluorescent luminaire is available for underpasses, floodlighting, perimeter, and ramp lighting.

2-Lamp Uni-directional Fluorescent Luminaire*

Readings were made of ramp installation consisting of ten 2-lamp uni-directional fluorescent luminaires. 22' mounting height—spaced 8' on center.

Dist. From Source	Vertical F.C.	Horizontal F.C.
50 ft.	9.70	6.50
100	2.40	1.20
150	1.10	0.35
200	0.65	0.05
250	0.40	—
300	0.25	—
350	0.20	—



4-lamp bi-directional fluorescent luminaire with 20 degree tilt is designed for the narrow street and entrance way.

4-Lamp Tilted Fluorescent Luminaire (20° Tilt)*

Spacing	Staggered 40' Street Width	Staggered 50' Street Width	Opposite 70' Street Width
75 ft.	1.50 A.F.C.	1.35 A.F.C.	—
100	1.15	1.05	1.60 A.F.C.
125	0.90	0.80	1.30
150	0.75	0.65	1.10
175	—	—	0.90

*From test reports E353-83, E353-817, E353-810, E353-88.

A Fluorescent Community is a Progressive Community. L-M fluorescent lighting means fewer accidents, less crime, more business.

L-M's New Fluorescent Street Lighting Luminaire
Large Light Source, Minimum Glare

By **STACY STANDLEY**
Manager
Lighting Sales
Line Material Company

L-M's New Fluorescent Luminaire is a revolutionary improvement in street lighting. With its large light source the fluorescent luminaire produces an even, cool white color over a large area. Because of its large light source, it provides virtually glareless illumination.

Fluorescent luminaires provide a light that is particularly advantageous in business and shopping sections. The surrounding sidewalk area adjacent to the curb is illuminated and gradually fades out to make the background contrast as gradual as possible. This provides a wider scope of vision for both the motorist and the pedestrian, in addition to creating a cheerful and active atmosphere in the shopping area.

L-M's New Fluorescent Luminaires are available in these styles:

1 4-lamp V-shape for use on wide streets

2 4-lamp bi-directional tilted 20° toward the street for narrower streets and entrance ways

3 4-lamp bi-directional with level horizontal mounting for center parkway and area lighting

4 2-lamp uni-directional for underpass, flood lighting, perimeter and ramp lighting

The fluorescent lamp used in these luminaires has a rated lamp life of 7500 hours. This longer lamp life reduces the cost of relamping luminaires below any other type now used for street lighting.

Features of L-M's New Fluorescent Luminaires

Large light source • Even, cool white color • Minimum glare • Low power consumption • Longer lamp life

Separate efficient reflecting system for each lamp • Good vertical component across the whole surface of the street • Good balance between building and road surface

Two lamp ballasts • Easy accessibility for relamping • Wiring terminal block easily accessible • Ballast can be removed very simply • Bracket adjustable ±5° for leveling.

L-M's fluorescent luminaires are easily accessible for cleaning, relamping, wiring terminal block and ballast removal. Four-lamp unit has two ballasts with one tube on either side of the luminaire paired to each ballast. Thus, if one tube burns out, the light output of the luminaire is reduced only 50% in each direction. Also, if desired, two lamps could be switched off for part night circuits.

Get Complete Information

Details of the new L-M fluorescent luminaires are available. Ask the L-M Field Engineer for information, or write Line Material Company, Milwaukee 1, Wisconsin (a McGraw Electric Company Division).

LINE MATERIAL Street Lighting

INDUSTRIAL PLIERS by CRESCENT

INDUSTRIAL PLANTS everywhere, especially in the Electronics field, will save in production time and tool cost with these new Crescent Pliers. The "SC" type pliers have plastic "CRESTOGRIP" handles — tough and long wearing yet soft and comfortable to the hand. Designed especially for assembly line workers, a light spring between the handles holds the plier open, ready for action, while a "color key" system quickly identifies the type. All flat nose pliers have red handles; chain nose pliers have green handles, and cutting pliers have orange handles.

"LONG REACH" type pliers have BOX JOINTS of improved design which will never loosen thus insuring smooth, easy action. Crescent electronically-controlled hardening guarantees positive grip and long, useful life.

No. 20 — 5" SC

FLAT NOSE PLIER with Spring and Crestogrip Handles. Knurled jaws for firm grip.

No. 22 — 5" SC

SHORT CHAIN NOSE PLIER with Spring and Crestogrip Handles. For fine work.

No. 942 — 4" SC

DIAGONAL CUTTING PLIER with Spring and Crestogrip Handles. Also made in 5 in. (942 — 5" SC) and 6 in. (942 — 6" SC) sizes. Keen, long lasting cutting edges.

No. 1033 — 6" SC

LONG CHAIN NOSE PLIER with Spring and Crestogrip Handles.

No. 1035 — BOX JOINT LONG REACH DUCK BILL PLIER. Overall length, 8 in. Nose length, 1½ in. Sure grip.

No. 1036 — BOX JOINT LONG REACH CHAIN NOSE PLIER. 8 in. long with 1½ in. nose. Forms loops and bends easily.

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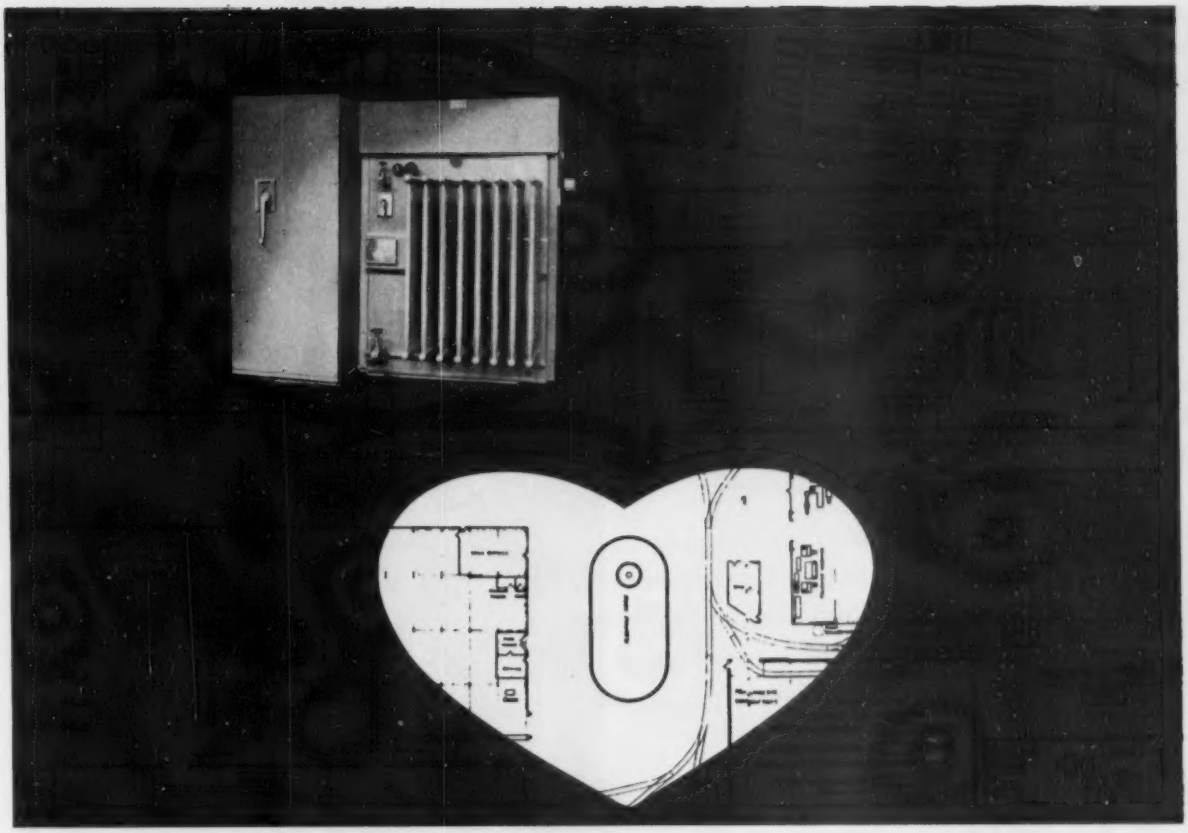
Give Wings to Work ®
Sign of the Artisan
Symbol of Excellence

Crescent is our trade-mark, registered in the United States and abroad, for wrenches and other tools. Sold by leading distributors and retailers everywhere and made only by

CRESCENT TOOL COMPANY, JAMESTOWN, NEW YORK



In the "heart" of your plant...

an UPTEGRAFF LOAD CENTER TRANSFORMER

reduces costs...improves power characteristics

Uptegraff announces a complete line of *Liquid Filled* LOAD CENTER TRANSFORMERS—150 KVA to 2500 KVA, 3 phase—designed for convenient installation with various types of switching equipment and terminal arrangements.

The use of Uptegraff Load Center Transformers offers savings up to 15 per cent as compared to the practice of using remote outdoor transformers to supply low-voltage power to machines and equipment located indoors. With load center transformers, costly low-voltage runs are kept to the minimum, and power characteristics are improved.

Uptegraff Load Center Transformers are designed and built specifically for this class of service. In addition to savings in installation costs, they offer substantial economies through operating efficiency. They are dependable and require the minimum of maintenance.

R. E. Uptegraff Manufacturing Co.

Scottdale, Pennsylvania

NEW HANDBOOK

The new Uptegraff Load Center Transformer Handbook simplifies the selection of a suitable unit, including auxiliary terminal equipment to provide the facilities you require. It gives overall dimensions and weights (including terminal devices, etc.) for all ratings from 150 to 2500 KVA,—3 phase. Write for a free copy. The coupon below is included for your convenience.

R. E. Uptegraff Manufacturing Company
Scottdale, Pennsylvania

Please send a copy of your LOAD CENTER TRANSFORMER brochure, Catalog 132, to:

Name _____ Position _____

Company _____

Address _____

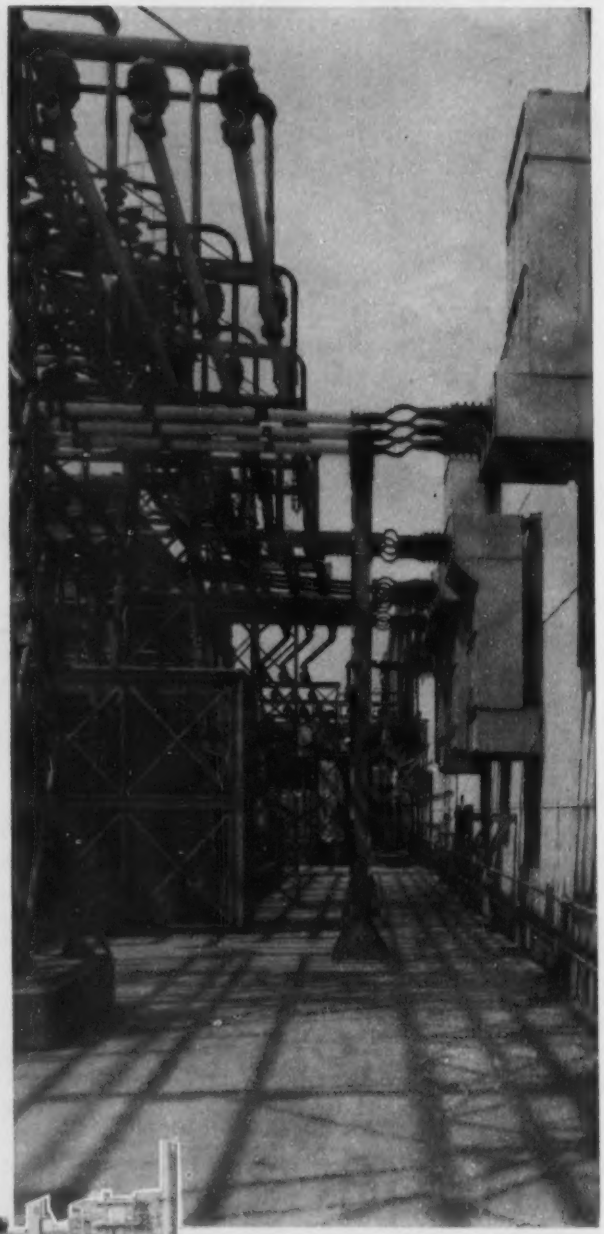
EW-9

Roller-Smith

15 KV. *HIGH VOLTAGE* BUS RUNS

At the Dallas Steam Electric Station of Dallas Power & Light Company, segregated phase bus runs furnished by Roller-Smith deliver 3500 amperes at 13,800 volts from the indoor switchgear to the outdoor transformer station.

The installation totalled approximately 900 feet of high voltage bus runs . . . segregated and non-segregated phase types . . . both 1200 and 3500 ampere and associated equipment for the interconnection of generators, switchgear and outdoor equipment.



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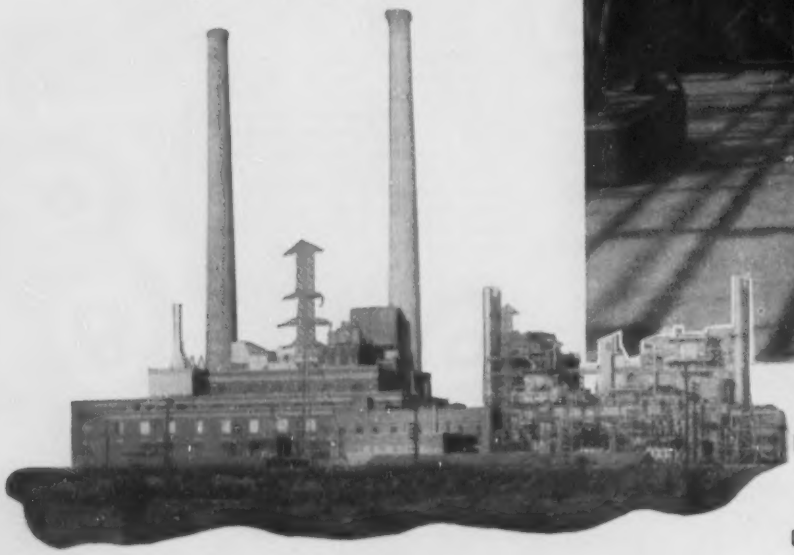
ELECTRICAL SWITCHGEAR
BETHLEHEM, PENNSYLVANIA

Roller-Smith Sales Representatives Located In All Principal Cities



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FOR
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TODAY'S BIG IDEA

IN HIGH VOLTAGE APPARATUS BUSHINGS

IS SMALLER, LIGHTER...

it's LOCKE'S type U

For 92 KV and above. Type U gives you all the desirable electrical characteristics of earlier bushings PLUS the added advantages of smaller dimensions and lighter weight.

For example, Locke's 161 KV Type U bushing is 6¼" smaller in ground sleeve diameter, and 590 lbs. lighter than its equivalent of earlier design.

This means transformers and oil circuit breakers can now be built lighter and smaller . . . something you've always wanted.

Locke Type U bushings are ideal for replacement purposes because they are easier to handle during installation . . . require less storage space.

Specify them for your apparatus.

DESIGN ADVANTAGES OF LOCKE'S TYPE U APPARATUS BUSHING

1. LIGHTER WEIGHT and smaller diameter made possible by a special oil-impregnated paper core with imbedded *conducting stress* equalizers. This, together with terminal and ground shielding, provides uniform internal voltage gradients as well as controlled external voltage distribution. The bushing is much smaller in weight and diameter without sacrifice of dielectric strength.

2. PERMANENT HIGH DIELECTRIC strength of paper core assured by positive seals and inert gas pressure against entrance of air and moisture.

3. INITIAL LOW POWER FACTOR of bushing *remains* low in service.

4. CAPACITANCE TAP is standard feature, providing a voltage supply for potential devices and simplifying power-factor testing.

5. CORONA-FREE, Locke Type U has excellent radio-influence voltage characteristics.

6. NO SERVICING REQUIRED other than periodic inspection and cleaning of porcelain surfaces.

For use at 69 KV and below, specify Locke's Type LC Bushing.

LOCKE

LOCKE DEPARTMENT
GENERAL ELECTRIC COMPANY
BALTIMORE, MARYLAND

—with Chase® Copper Bus Conductors!

Chase Square Copper Tube Bus Conductors are *ventilated* so more heat is *dissipated.* Result: current-carrying capacity is increased *up to 20%*. They'll handle even heavy short-circuit currents—and are strong enough for use in longer unsupported lengths. Call your nearest Chase Warehouse or Sales Office.

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Boston	Dallas	Indianapolis	Minneapolis	Philadelphia	St. Louis	(†sales office only)

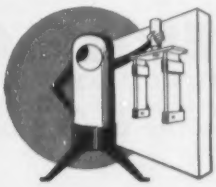
CONTROLLING STREET LIGHTS IN PROVIDENCE, R. I.

Motorists and pedestrians in Providence can thank their City Government for authorizing The Narragansett Electric Company to install dependable, automatically controlled street illumination.

The use of Fisher-Pierce street lighting controls assures dependable *automatic* illumination of streets the moment daylight drops below a safe value. Because F-P controls are photoelectric, they operate regardless of the hour, the season or the weather.

On the job in Providence since 1946, F-P controls now number about 3000. Narragansett engineers report favorable installation economics *and* an extremely low failure rate — only 2.29% of *all* units during a recent 12-month period.

Long, dependable service of F-P controls — in street lighting control systems in Providence and hundreds of *other* communities — is the basic reason Fisher-Pierce is recognized as a *leader* in its field.



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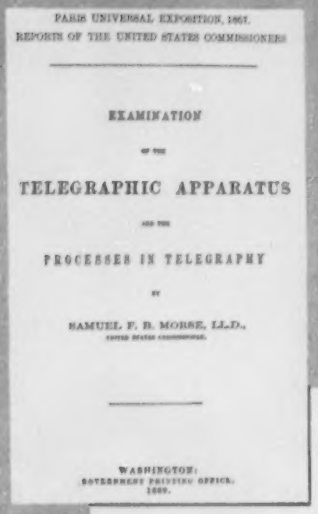
IN CANADA:
NORTHERN ELECTRIC CO., Ltd.


PARIS UNIVERSAL EXPOSITION, 1867.
REPORTS OF THE UNITED STATES COMMISSIONERS

EXAMINATION

TELEGRAPHIC APPARATUS

PROCESSES IN TELEGRAPHY

SAMUEL F. B. MORSE, LL.D.

WASHINGTON:
GOVERNMENT PRINTING OFFICE.
1869.

KERITE'S 100th Anniversary

1854—1954

Read what Professor B. Silliman of Yale University reported on the Kerite insulation exhibited at the Paris Universal Exposition of 1867.

TELEGRAPHIC APPARATUS, ETC.

DAY'S KERITE INSULATOR.

The kerite compounds of Austin Goodyear Day, mentioned in the following memoir, were honored by two medals and an honorable mention by the jury of the Exposition Universelle, to whom the subject was referred. These awards covered other products than the electrical cables and insulators which are the special object of the descriptive memoir.

NOTE UPON INSULATION AND KERITE, BY PROFESSOR SILLIMAN.

The exhibition of the kerite, this product of the persevering labors and experiments of Mr. Day for so many years, furnishes an example of the not infrequent inappreciation, or rather overlooking, of an invaluable discovery, when modestly presented, as in this case, among the more showy articles by which it was surrounded.

True, it received honorable mention as "artificial India-rubber," and a bronze medal for its very limited application to "India-rubber cases;" but its superlative value as a substitute in insulation for India-rubber and gutta-percha was not, for it could scarcely be, appreciated, presented as it was simply in one of its more ordinary applications; so that heedless neglect is not charged upon the jury, but it is mentioned rather as an example of the existence of an unnoticed quality in an apparently trifling discovery, necessarily latent to superficial inquiry; a quality which is destined in this case to have a most important bearing upon submarine and subterranean telegraphy.

The kerite, in its condition simply as artificial [illegible] ssed under

The value and service life of a product can be no greater than the integrity and craftsmanship of its maker.

KERITE CABLE

THE KERITE COMPANY—30 Church St., New York 7, N. Y.
Offices also at 122 S. Michigan Ave., Chicago; 582 Market St., San Francisco;
3901 San Fernando Rd., Glendale 4, Calif.; 31 St. James Ave., Boston

It's Time to Tell the Public

Utility leaders have read with dismay Electrical World's July 26 editorial, "Drop Frequency to Warn of Air Raids." Their objection is that close control of frequency is essential to many electrical functions. Deliberately to drop frequency as a means of spreading air raid warnings could only be done by separating system interconnections which are of utmost value in times of distress.

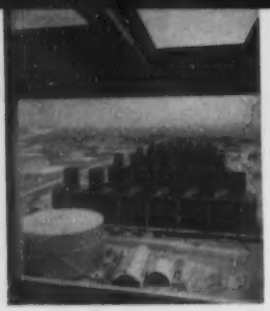
Electrical World shares their dismay, but for a different reason. Its editors are keenly aware of the paucity of dependable information about air-raid preparations presented to the public. In their travels they encounter a highly confusing divergence in practices and almost complete lack of guidance to the traveling public.

The public craves leadership. When statements of "experts" are reported from Washington, they are eagerly accepted as dependable. Such reports revived the frequency-drop principle early in July and flashed it from coast to coast. Lack of comment by utilities gave the impression of acceptance. Again the public was left with the impression that a great problem had been solved. And again they will be quick to castigate those utilities which fail to cooperate.

If the utility industry is to avoid this castigation, it must act promptly to tell what can—or cannot—be achieved via its facilities. This proposal, for example, appears completely impractical. Industry spokesmen should say so and present convincing and bona-fide reasons. The difficulties involved in altering the frequency of vast interconnected systems and inability to segregate just the area designated for alerting should be explained. And the questions of what device shall be placed in each home and who will pay for and service it should be settled.

Business courtesy may dictate that these comments be presented first to responsible public officials. This was done months ago. But when these officials ignore the industry's protest and present their plan to the public, then the industry should feel obligated to publicize its position. Proper presentation should earn enhanced public support. Failure to present its case, on the other hand, will be construed as insincerity in the protests filed privately with public officials.

Readers fear that Electrical World's editorial may be construed as endorsement of frequency dropping to warn of air raids. If this is the only result, then Electrical World has erred indeed. But if this editorial succeeds in alerting the utility industry to the vital need for public utterance in matters of national emergency, then it has achieved its real objective—see letter on this subject on page 164.



Water Cooling Towers Become Part of the American Scene

A characteristic feature of many British and European power stations has been the water cooling tower—usually of the sheaf-of-wheat natural-draft pattern. Until very recently U. S. plants were unusual if they were accompanied by any form of cooling tower. Now in the current surge of capacity additions there has been a sudden and large-scale adoption of such means for cooling otherwise scanty supplies of condensing water. It was almost as if there were a realization that the power industry could run out of rivers or out of ocean-front sites before it runs out of fuel.

Anyhow 38 installations were made in 1953 alone, and these averaged well above $100,000 each in outlay. Since 1948 there have been many other cooling tower installations, and the operating facts and costs are reported for 52 of them on other pages of this issue.

Here then is a new venture on the part of the utilities. It involves different concepts of heat exchange than are conventionally encountered inside the power plant. It calls for progressive familiarity with evaporation into more or less humid air. It means dependence on factors that cannot be as readily regimented as those administered in the orthodox heat cycle. In short the cooling tower art is off on the fringe of the normal consciousness and ken of the power plant designer and operator.

It is not strange, therefore, that there should be a rather sizeable spread in temperature ranges, cooling plant sizes, and power requirements for the cooling towers. Admittedly the local conditions will account for some of this spread, but perhaps the rest of it can be charged to the comparative unfamiliarity of power engineers with the science of water cooling by air circulation. Electrical World presents the comprehensive data in this issue in the expectation that they can be useful in sharpening the figuring for the next job that requires supplemental cooling. Unless all signs fail, there are going to be more such installations as more plants are located where the load is rather than where the water is.

Equipment Life vs Output

It is an accepted fact that practically any piece of equipment can be worked harder and oftener for the sake of greater output. But does it pay to incur the almost inevitable shortening of equipment life by such overworking? The answer is found in the same kind of economic balancing that has led some companies to put more load on transformers and on cables knowing full well that the increased duty would quite likely result in somewhat earlier burnout.

More recently there has been a disposition to apply the same kind of exploratory thinking to power plant equipment, particularly the hydro generators. That is a good place to start because the set-up is simple. The dam and penstocks are relatively immune to loading variations, and the principal concern is the windings of the generator. It should not be so difficult to determine if it would not be good business to accept greater frequency of stator winding replacement for the sake of greater annual kwhr output. The latter goal would certainly seem attractive if water is ever allowed to go to waste over the spillways rather than put more load on the generator.

V. W. Ruskin of Canadian-Brazilian Finance has been an exponent of this philosophy for hydro plants in Electrical World pages and on the AIEE platform. Anyone with an eight-generator station could be tempted, he shows, to incur life-shortening of windings from fifty to 7 years for the sake of getting 462,000,000 kwhr additional at an added value of better than $1,000,000 by 20% overloading to 126 C.

Steam stations are more complex. There are the boiler and turbine as well as the generator, not to mention the multiplicity of auxiliaries. Nor perhaps can one completely ignore the impact of equipment insurance and its effect on maintenance, inspection, and other policies. Nevertheless, the apparent gains are so real that it can only be a matter of time before some of the hydro thinking begins to be applied to steam stations. What with new levels of capability, new methods of cooling windings, new high-temperature insulations, and new instruments for supervision, it should not take too much courage to toy with the economies of overloading of steam plant components for sound profit.

A Ton Is Equal to 2,000 Lb

In the quarter ended June 30 the aluminum industry set a production record of 732,515,499 lb. The producers can well be proud. Less than five years ago they were under fire from the administration at Washington for not producing enough and were being threatened with government competition so that the demands of the nation for aluminum could be supplied.

But the producers could be equally proud if the figure had been reported as 366,258 tons, the approximate equivalent of 732,515,499 lb. However, the industry still prefers to have its production reported in pounds, a custom originated in its infancy when even yearly output was extremely small.

Today the aluminum industry has grown up. The light metal has won for itself a firm place among metals commonly used by American industry. It is time that its production, like that of coal, copper, and steel, be reported in the lesser ton figure.

THE ELECTRICAL WEEK

The Issue's News Highlights . . . Two TVA directors countered Budget Bureau's directive to start negotiating with AEC on Dixon-Yates contract with a demand for "clarification" of proposal's details.

Reclamation is making restudy of Trinity project in California to see if local utilities, public or private, might install power facilities . . . Drought conditions in Southwest have forced SPA to cut power sales to Arkansas P&L and Texas P&L.

Hurricane Carol caused extensive damage in New England and Long Island, while companies to the south reported little to no damage. Trees were the main cause of trouble to distribution circuits, and no generating plants were reported damaged.

In New England electric service was hard hit by the 100-mph winds which caused an estimated $400-million damage. Boston Edison mobilized 50 line crews from outside New England. New England Electric System and utilities in New Hampshire and Maine suffered widespread distribution damage, so extensive that outage figures were not available.

Connecticut L&P reported 100,000 customers were out of service. Connecticut Power's generating plant in Stamford was saved by sand bagging, and its New London Division suffered worst. United Illuminating estimated 30,000 customers out of service.

Long Island Lighting estimated service to 275,000 customers was interrupted when 1,600 trees were felled across lines and 350 poles were blown down. Consolidated Edison had 105,000 customers out of service.

Pacific P&L agreed to sell 70 miles of distribution lines, embracing 2,141 customers, to Eugene (Ore.) Water & Electric for $1.2 million. Area was part of territory involved in a condemnation suit.

ASME medals will be presented to two utility men: Walker L. Cisler, president, Detroit Edison, will receive the ASME George Westinghouse Gold Medal Award, and Edwin B. Powell, Stone & Webster Engineering will get the ASME Medal.

Spokesman for Northwest Mississippi Public Power District says the newly organized group does not intend to condemn property of Mississippi P&L. The PPD would serve portions of Tate and De Soto Counties which now are supplied by MP&L and North Central Electric Power Association, a co-op which is in financial straits. The PPD would absorb the co-op but has not announced whether it will buy its power or generate it. Mississippi P&L is challenging operation of PPD in the courts on the ground that "public necessity and convenience" does not require such action.

Off the Washington Wire . . . Speculation in Washington is that President Eisenhower may take disciplinary action if two TVA board members fail to swing into line on the Dixon-Yates contract. Dr Harry Curtis and Raymond Paty, the board's two Democratic holdovers, have demanded "clarification" of details of proposal after receiving a Budget Bureau directive to meet promptly with AEC to negotiate a follow-up contract (see page 62). Whether action would include firing them no one knows, but the precedent was set 16 years ago when Roosevelt dismissed TVA Director A. E. Morgan.

Bonneville power rates will not increase for at least two years. BPA has just filed proposed five-year rate schedules with Federal Power Commission saying the present base rate of $17.50 per kw-year will be continued until at least December, 1956. An adjustment clause in each schedule permits a rate increase in December, 1956, or in each of the following two years, if necessary. A simplified billing procedure and discount provision for irrigation rates retain incentives to increase irrigation loads and at the same time make power billing work easier.

FPC has started studies to determine whether hydro projects of Southern California Edison Co, Pacific Gas & Electric Co, and Pennsylvania Electric Co will benefit from federal dams. If they do benefit, the government will assess the firms.

FPC has authorized the merger of Coast Counties Gas & Electric Co into Pacific Gas & Electric.

Alabama Power Co inaugurated an adequate-wiring financing plan that requires a 10% down payment with balance to be paid within 24 months at a minimum of $5 a month. Maximum amount financed is $500 and minimum is $30.

New "Wire on Time" Plan of Pennsylvania P&L covers financing of wiring and plumbing for electric ranges and water heaters from Sept. 15 through Dec. 31, 1954. Plan features no down payment, up to three years to pay, $1.00 a month minimum, and covers installation costs from $25 to $150 per customer.

Pacific G&E and IBEW have agreed on a 2½% wage increase to be effective until July 1, 1956.

California Oregon Power Co asked FPC approval to sell 22 miles of transmission line to BPA for $249,979.

Executive Changes . . . J. K. Horton, president of Coast Counties Gas & Electric, was elected a vice president of the parent firm, Pacific Gas & Electric . . . W. M. Wade, formerly vice president of Alabama Power's Southeast Division, was appointed the utility's Western Division vice president.

TVA Asks Dixon-Yates 'Clarification'

Authority implies it will not join negotiations without complete explanation of contract details. Congressional hearing on controversial proposal postponed until end of September

Tennessee Valley Authority has moved right into the enemy camp in its squabble with the Atomic Energy Commission over the Dixon-Yates power supply contract.

Two TVA directors—Vice Chairman Dr Harry Curtis and Raymond Paty—sent a sharp note to the Budget Bureau demanding complete "clarification" of the details of the proposed contract. Otherwise, the implication was clear, TVA will not move one step in negotiating a follow-up contract with AEC. Budget Bureau had directed TVA to meet promptly with AEC.

The proposal made by Southern Co (whose chairman is E. A. Yates) and Middle South Utilities (whose president is Edgar Dixon) calls for construction of a 650,000-kw steam plant at West Memphis, Ark. The power would replace power TVA now supplies to AEC from its Shawnee steam plant.

Hearing Is Stalled

TVA's action stalled the Administration's plans to bring its big guns to a full-dress Congressional hearing so that documented answers could be supplied to counter Democratic charges that the deal is a "scandal, shot full of favoritism," that it was broached in a "corrupt" atmosphere of political "gyrations" and that its details are being withheld from the public without good reason.

Chairman W. Sterling Cole (R-N. Y.) of the Joint Atomic Energy Committee had originally scheduled an open hearing on the contract for Sept. 2. After repeated blasts from Democratic National Chairman Stephen A. Mitchell, Cole asked Mitchell to present formal charges to the Joint Committee. At that hearing, Cole had planned to hear also from the Federal Power Commission and AEC.

According to Cole, however, AEC last week requested a postponement of several weeks because it was not yet prepared to discuss the details of the proposed contract in public. Cole said the hearing would be set again for the latter part of September.

The TVA letter to the Budget Bureau then came to light. Its five pages will not be released by the bureau until a budget reply has been sent to TVA, but it is reported that the two TVA directors made it plain they wanted full details of the Dixon-Yates proposal as it stands today before they would sit down with AEC and negotiate.

Obviously, the Administration does not want to become engaged in open political debate with public power forces in a Congressional hearing if part of its team is allied with the Democrats. This explains the last-minute rescheduling of the hearing, and it means that public disclosure of the contract's details will undoubtedly be held up for some weeks.

An earlier report was circulated to the effect that TVA would refuse to sign the Dixon-Yates contract. The letter to the Budget Bureau did not take such a forceful stand as this, but it was written in the form of an ultimatum.

Several drafts of the contract have been supplied to the Joint Committee. AEC General Manager K. D. Nichols advised the committee to regard the latest draft, submitted Aug. 11, as "in final form."

Whether the AEC commissioners will approve the provisions of that draft remains to be seen. But, if they do, this much is clear—the contract will be legal. This was established last week when President Eisenhower signed into law the new atomic energy bill, which gives specific sanction to such agreements with private utilities.

Details Still Secret

Delay in public disclosure of the details of the contract has given the Democrats a chance to make political hay. Democratic Chairman Mitchell, Rep Emanuel Celler (D-N. Y.) and others have indicated it will be eye-opening when made public. Mitchell has promised to keep the matter boiling so that it will be a hot political issue during the Congressional elections this fall.

The contract's provisions are the current subject of partisan debate, but there is another matter still to be cleared up. In fact, it was on this subject that the Joint Committee meeting technically was to be based. That is the question of waiving a required waiting period to permit signing of the final Dixon-Yates contract during Congressional adjournment. The new atomic law provides that, unless this is waived by the Joint Committee, a contract of this sort must lay before the group for at least 30 days while Congress is in session. AEC warned that failure to grant a waiver will delay construction of the $107-million, 650,000-kw plant until next year.

Probable Witnesses

When the Joint Committee hearing is again rescheduled, these interested parties, in addition to AEC, TVA, and Mitchell, may be called on to present their views:

- Justice Department, whose views on the contract's provisions may be sought. Cole said the Joint Committee has not solicited advice from the Attorney General, but there is the possibility he may be called as a legal expert.
- National Rural Electric Cooperative Association, which has asked to be heard. Executive manager Clyde T. Ellis said his organization has a "vital" interest in the Dixon-Yates power contract.
- New York industrial consultant Walter von Tresckow, who heads a group which made an unsuccessful effort to compete with Dixon-Yates for the AEC-TVA business. In a recent letter to Chairman Cole, von Tresckow declared President Eisenhower was "deliberately" misled in choosing Dixon-Yates offer to supply power in the Memphis area.

Making Atomic Power Industry Lawful

President Eisenhower signs into law the atomic energy bill which creates a private atomic power industry and permits greater exchange of atomic information among American allies. With the President is W. Sterling Cole (R-N. Y.), chairman of the Joint Congressional Committee on Atomic Energy.

The new motto on the President's desk, "suaviter in modo, fortiter in re," roughly translated means "gentle in manner, strong in action."

Kentucky Co-op's Funds for New Unit Are Freed

East Kentucky Rural Electric Cooperative Corp, Winchester, Ky., has received approval from Rural Electrification Administration to use $13,299,400 from an earlier generation-transmission loan for addition of a 66,000-kw generating unit and expansion of its transmission system.

These funds—part of the co-op's $27,982,000 loan—had been under an REA stop order pending development of a lower-cost power supply plan for the eastern two-thirds of the state of Kentucky.

REA approval clears the way for the co-op to carry out its planned expansion of the recently dedicated William C. Dale power station at Ford, Ky., and complete the transmission network needed to serve 15 of its 19 member distribution co-ops. The 15 are in an area covered by an interconnection and integration agreement with Kentucky Utilities Co (EW. March 15, p 9) which REA approved last June.

Dedication ceremonies were held Aug. 28 for the plant named for William C. Dale, first president of the co-op. The plant, scheduled to be completed in 1957, is designed to serve about 150,000 rural families in 85 counties.

One 22,000-kw generator is in operation at the plant and another 22,000-kw generator is expected to be placed in operation within the next 30 days.

The proposed 66,000-kw unit, slated to cost about $7.5 million, will be the largest constructed with REA loan funds. The plant, which will have a nameplate capacity of 110,000-kw, will be the largest single station financed by REA.

Total cost of the plant and transmission lines is estimated at $30 million.

In another development involving East Kentucky, a rehearing has been asked by the Kentucky Power Co on Public Service Commission's approval of the co-op's application to build 146 additional miles of transmission lines. Cost of this project is estimated at $1,296,000.

Kentucky Power had protested against the co-op proposal. Early in August PSC revealed it had granted East Kentucky authority for the construction.

Trinity Dispute . . .

. . . looms in California as USBR restudies project to see if local utility can develop power

A controversy reminiscent of the Hells Canyon private-vs-public power fight has developed as a result of an announcement that Bureau of Reclamation is making a restudy of the Trinity project in California to determine if the falling water to be made available from a system of dams and tunnels should be turned over to public or private agencies for the development of hydroelectric energy.

The restudy announcement indicated the government's expenditure on the $216-million project may be reduced by $60 million if the bureau determined it would be feasible to permit an agency other than the federal government to build the power plants.

The Trinity development would provide additional water for the Central Valley Project. Bills have been introduced in Congress to authorize construction of the Trinity works to gain the water necessary for irrigating land in the San Joaquin Valley's west side.

PG&E Interested . . . Pacific Gas & Electric Co has signified a willingness to buy the falling water to be made available by the Trinity project and to construct power plants with private funds.

Clyde H. Spencer, Sacramento regional director of the bureau, said PG&E's proposal is being studied and the bureau is awaiting additional information from the California company.

Newspapers in the Central Valley region found many critics of the plan, including U. S. Sen Thomas H. Kuchel (R-Calif.), who expressed the view the development should be financed solely by the federal government.

It was pointed out most of the power to be developed would be necessary to operate the pumps to get the water into the San Luis reservoir in San Joaquin County after it is transferred at the Sacramento-San Joaquin delta.

Opposition Groups . . . California Water and Power Users Association, recently organized, joined the battle

Jubilee Farm Opens Its Gates

Light's Diamond Jubilee Farm, called the most highly electrified in nation, was inspected for first time Aug. 26 by some 300 persons of the electric and agriculture industries. Speakers (below) included Wheeler McMillan, left, editor-in-chief of Farm Journal magazine; Ralph Beard, Allis-Chalmers Manufacturing Co and chairman of National Electrical Manufacturers Association's Farm Electrification Council; J. B. McCurley, Jr, chief of Operations Division, Rural Electrification Administration; and Pres Charles Oakes, Pennsylvania Power & Light Co. Farm, with more than 150 kw connected load, is joint project of Farm Journal and PP&L with cooperation of NEMA and National Electrical Contractors Association, Inc. Privately owned, it is located near Carlisle, Pa.

Trinity Dispute

in opposition to any private development on the Trinity project.

Officials of the National Hells Canyon Association appeared at a meeting of the California group in Sacramento Aug. 28 and pledged their support in what they termed a private power grab similar to a proposal by Idaho Power Co to build power dams on the Snake River where the bureau had made studies for power and water projects.

Clyde T. Ellis of Washington, D. C., executive manager of the National Rural Electric Cooperative Association, told the meeting "the rural electrification program and the people's power program are fighting for their lives."

He charged under the Administration's power policy "the people's resources are being turned over to private monopoly."

The association adopted a 12-point statement of principles and objectives, mostly in support of public development of power resources.

George Sehlmeyer of Sacramento, master of the California State Grange, was elected president of the association and he pledged the organization's executives to a "vigorous fight to conserve the natural resources of those to whom they belong, all the people."

PUD's, Cities Ask to Join in Building Priest Rapids

Five PUD's and three municipalities have served notice on the Washington State Power Commission that they wish to join Grant County PUD in the proposed construction of $360-million Priest Rapids Dam on the Columbia River. They are largely the same agencies which petitioned the commission for establishment of Joint Operating Agency No. 1, a petition upon which the commission has postponed action indefinitely.

The Washington State PUD Association, in addition, asked the commission to reconsider its previous decision to apply to the Federal Power Commission for a preliminary permit to build the dam itself. Grant PUD previously had applied for a permit.

The five PUD's cooperating with Grant are those of Ferry, Grays Harbor, Chelan, Pacific, and Kittitas Counties, while municipalities are Ellensburg, Sumas, and McCleary.

At a meeting Aug. 20 at Ephrata, Wash., Grant PUD rejected the state power commission's offer for a joint application for a permit to study the Priest Rapids project. (EW, Aug. 30, p 5). The PUD said it could not place its own application in jeopardy by joining with a power commission whose authority had not been tested in the state's courts.

A spokesman for Harza Engineering Co, which has been surveying the site for the PUD, told the Ephrata meeting that cost of the project might reach $500 million.

SPA Power Cuts

Drought forces agency to reduce its sales to Texas P&L and Arkansas P&L

Continued extreme drought conditions in the Southwestern Power Administration area have led to SPA agreements with Texas Power & Light Co and Arkansas Power & Light Co to free upwards of 68 million kwhr over the next three months.

The arrangement, according to SPA spokesmen in Washington, will ease the system's load to this extent in order to make available power needed by other customers threatened with a shortage.

The agreements provide:

- Texas P&L requirements from Denison Dam on the Red River will be reduced up to 8 million kwhr during September. If an extension of this arrangement is needed, the amount of reduction will be renegotiated.
- Arkansas P&L will defer up to 20 million kwhr each month for the next three months, reducing its commitment to Reynolds Metals Co from 30 million kwhr to 10 million kwhr a month during that time. The arrangement provides that SPA return this "lost" power over the next four years, or sooner if possible.

Rates in either case are contract rates, no matter when delivery is effected.

SPA said that, when water conditions continued to worsen, it was faced with the alternatives of reducing load or obtaining steam power. The agreements solve this dilemma for the present.

Cathode System Installed by PG&E for U. S. Ships

A $500,000 installation of underwater cables designed to keep a fleet of ships free from rust has been completed by Pacific Gas & Electric Co.

The new electric cathode installation at Suisun Bay, Calif., is expected to reduce maintenance problems for 350 Maritime Administration Reserve Fleet vessels moored there.

The cathodic system reverses the rust-generating mechanism—the electric current which ordinarily travels from a ship into the water. The rusting process is halted by sending a current into the hull from the water.

"It's done by laying cables strung with carbon-graphite anodes on the bottom of the bay on each side of the ship," explains Frank Stanley, fleet electrician who worked with PG&E engineers on the system. "This network of cables is connected to cables from the main power line on shore. We run a direct 24-v current through the cables and into the hulls. Transformers and rectifiers are installed on the ships."

Savings are estimated at $1,300 per ship annually.

Grand Coulee Blasted in H-Bomb Test Raid

Grand Coulee Dam on the Columbia River in eastern Washington State was "hit" by a hydrogen bomb Aug. 23 in "Operation Floodout" conducted by the state civil defense organization.

If all the assumptions in the operation had become true, 60% of the state's electric power would have been knocked out and the entire Columbia River area from the dam to the ocean would have been flooded.

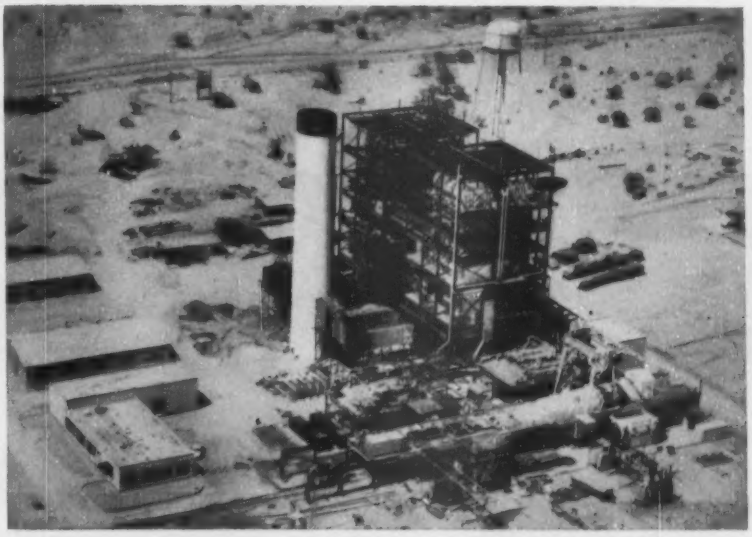
Hydro Project Harnessing 6 Rivers Planned in Cuba

HAVANA, Cuba (McGraw-Hill World News)—Cuba is planning to harness the power of six of its rivers to produce cheap electricity for the benefit of agriculture and industry.

In a recent signing ceremony held at the Banco Nacional de Cuba, the First Cuban Hydroelectric Plant (PRICHEC) was legally constituted by the Agricultural and Industrial Development Bank of Cuba.

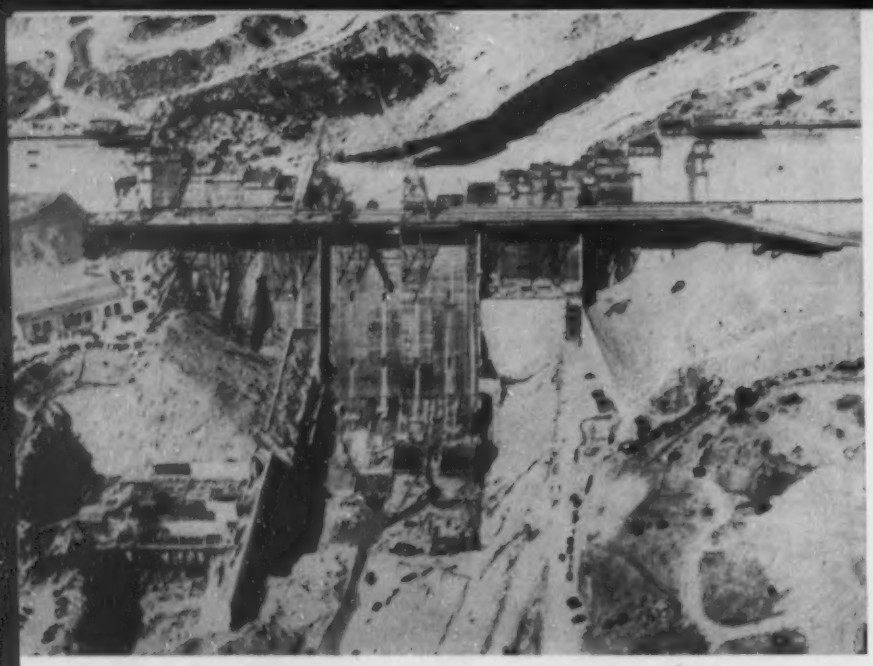
Creation of PRICHEC had been authorized by a 1953 decree, which granted the bank exclusive and perpetual rights to exploit the waters of the rivers Hanabanilla, Guanayara, Negro, Jibacoa, Pretiles, and Boquerones.

Following the signing ceremony, BANFAIC officials proceeded to sign contracts with the Knappen-Tibbets-Abett-McCarthy firm of New York to draw up plans for the hydro project and to supervise its construction. Preliminary studies by this firm indicate that the six rivers could be used to build a plant capable of producing 224,000 kwhr daily.



Big Power Producer in Arizona

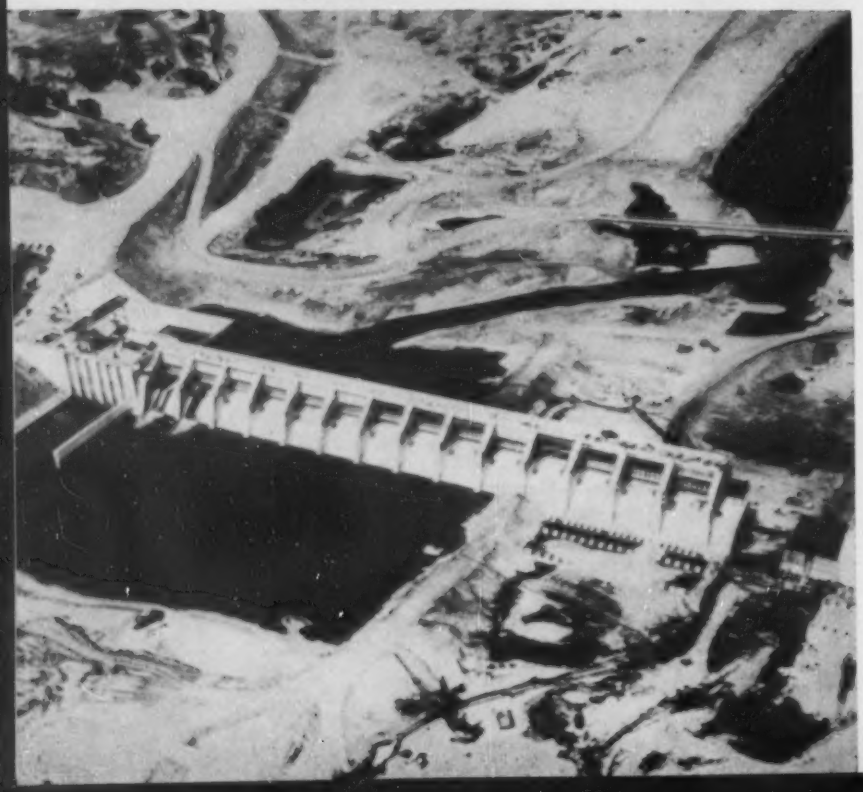
Aerial view of Arizona Public Service Co's new $24.5-million Saguaro steam plant at Red Rock, between Phoenix and Tucson, shows advanced stage of construction work. One 100,000-kw unit already is on the line and a second unit of similar size is being completed. The plant is situated at the southern end of the system's distribution lines and ties into Bureau of Reclamation lines to equalize the distribution load from Hoover and Davis Dams on the Colorado River, and the company's generating facilities at Phoenix.



2 Dams on American River—Folsom

Construction work on two federal projects near Sacramento, Calif., is entering the homestretch. Folsom Dam (above), a $30-million Army Corps of Engineers project on the American River, is 85% complete. Work has started on tailrace channel. The project's $5.7-million, 162,000-kw power plant is seen in early construction stage at lower left. Nimbus Dam (below), seven miles downstream, is practically finished. The $6-million structure will serve as afterbay dam for Folsom. Two openings at left will permit this year's salmon to swim upstream to spawn. Next year a fish hatchery will be complete, permitting artificial spawning of salmon, and openings will be closed. Power plant is at left.

and Nimbus—Are Nearly Completed



POWER BRIEFS

● Connecticut Light & Power Co plans to open its new 75,000-kw Montville plant installation on Sept. 17 as part of the nationwide celebration of Light's Diamond Jubilee.

● Tacoma (Wash.) City Council has authorized construction of a 275-ft high diversion dam on the south fork of the Snohomish River to increase power output of its Cushman plant. To finance the project, the council also approved plans to issue $22.5 million in bonds.

● Canadian government has granted Northwest Power Industries, Ltd, a priority permit assuring the firm first consideration for its plans for a $270-million hydro power development along the British Columbia-Yukon border in the Atlin Lake area.

● Pennsylvania Electric Co has placed in commercial operation the second of two 137,500-kw units at the $40-million Shawville station of the West Branch of the Susquehanna River near Clearfield, Pa.

● Federal Power Commission has granted Chelan County (Wash.) PUD a 36-month preliminary permit for a proposed hydroelectric project on the Columbia River. The power plant will contain nine 65,000-kw generating units initially. Provision will be made for installation of five additional units at a later date.

● First unit of Pennsylvania Power & Light Co's new Martins Creek plant has been placed in operation. The new 132,500-kw turbogenerator is the largest in the PP&L system.

AEC to Build Reactor for Irradiation Testing

Atomic Energy Commission will build a $2.8-million irradiation testing reactor at its Oak Ridge (Tenn.) Laboratory. It will be used primarily for research and development on fuels, materials and components suitable for use in power and other reactors.

The reactor will be of the heterogeneous type and will use enriched uranium as fuel. It will use ordinary water as a moderator and coolant. Power level will be 5 Mw of heat.

AEC expects the new reactor will be ready for operation "in less than three years."

Fish-vs-Power Conflict Aired

Northwest Governors' subcommittee reports fisheries' problem is most serious obstacle blocking new hydro projects

Actual building of 36 proposed hydroelectric projects in the Pacific Northwest is being delayed by various obstacles and the "most comprehensive of these is the problem of fisheries," engineering subcommittee of Pacific Northwest Governors' Committee reported at a meeting in Portland, Ore., last month.

Earlier in the meeting Columbia River basin fisheries interests were invited by the Governors' Committee to participate in studies by the engineering subcommittee in the fish-vs-power conflict.

Sept. 8 Meeting Planned . . . Representatives of the fisheries groups at the Portland conference complained that basin resource development programs were not taking sufficient steps to protect the salmon which spawn in the basin headwaters. They agreed to meet with the engineering subcommittee on the problem and selected a nine-member group to attend a Sept. 8 conference.

In its analysis of the fisheries situation the engineering subcommittee declared:

- Some degree of fish-vs-power conflict exists in the course of planning and developing "substantially all major hydro projects" but it is not foreseen that this can be avoided by selecting projects other than the 36 proposed in the committee's second report.
- Fisheries' conflicts may impede construction of dams which would produce 4 million kw or about half the capacity needed by 1969 and that to avoid serious restriction of power supply all fisheries and non-fisheries problems at some projects must be resolved by early 1955.
- Both the "adequate preservation of fishery values and the production of necessary and required hydro power can be had simultaneously."

In evaluating project requirements to meet minimum loads, the report concludes that unless fishery and other problems are resolved there will be a shortage of 900,000 kw in the fall-winter months of 1960-61, that by 1963 fishery issues must be settled for projects with 3,850,000 kw and other problems must be solved for projects with 3,850,000 kw.

The governors' engineering subcommittee, headed by W. Jack Mosley, estimated that minimum supply needs in the next 15 years in the Northwest call for 11.6 million kw of new capacity by 1969. Projects under construction will provide for 3.9 million kw and the 36 hydro projects proposed by agencies and utilities could produce 8 million kw by 1969. In stressing that these were minimum requirements, Mosley pointed out that the subcommitte had projected load growth for the next 15 years on the premise of a 6.62% annual gain whereas load has increased 7.39% a year from 1920 to 1953 and has increased an average of 9.26% during each of the last five years.

CBIAC Meeting . . . Columbia Basin Interagency Committee, from which the governor's group is an offspring, also held a meeting in Portland on Aug. 18. The committee met to review a new charter proposal which would broaden CBIAC membership to include voting privileges for the governors of the states. The charter would also extend the group's interest into the field of resource management, particularly water resources which the organization's planning work on dams and irrigation work has affected.

In addition to planning activities, CBIAC would concern itself with coordinating project construction, operation, and maintenance.

CBIAC will hold its next meeting Oct. 20 at Missoula, Mont.

Speed Work on Dalles Dam Powerhouse

Work on the powerhouse at The Dalles Dam on the Columbia River is being pushed to regain a schedule after a setback last May when a concrete batching plant collapsed. Time lost is expected to be recouped by mid-October, according to Superintendent J. D. Heckart. Completion of this phase of work is set for September, 1955. Intake gate slots and turbine draft can be seen in the above view of the powerhouse substructure.

Initial installation at the $350-million multipurpose project of the Army Corps of Engineers is slated to be 14 generators rated at 76,000 kw each. A total of 22 is contemplated.

Relocation Study

Bureau of Roads asks utilities to furnish data on cost of moving facilities

Questionnaires are going out to all types of utilities so Bureau of Public Roads can get an idea of how much it costs to relocate their facilities because of highway improvement.

Section 11 of the $1-billion federal-aid Highway Act of 1954 directs the Secretary of Commerce to study relocation problems. Data is to be transmitted next year to Congress, presumably for later use in considering bills to provide federal reimbursement of relocation costs. Such legislation has been offered regularly in the last few years.

One-Page Questionnaire . . . The one-page questionnaire now making the rounds was drawn up by the bureau, then submitted at an Aug. 20 meeting to representatives of 25 public utilities for review and comment. Answers will provide the government with its first complete set of figures on utilities relocation costs.

The government estimates it spent somewhere in the neighborhood of $500,000 last year for relocation of utility facilities. It is now in the process of gathering its own expenditure figures for this purpose over the last five years, and it hopes to receive from the individual states their estimates of similar expenditures for the last year. But in neither case is there a reliable set of figures in existence.

Congress has told the bureau to submit a report by February 1955, so the bureau has asked, informally, that questionnaires be completed and returned in October, 1954.

Fact-Finding Study . . . After the meeting to discuss the form of the questionnaires, Commissioner of Public Roads Francis V. Du Pont made it clear the study is aimed at fact gathering only, and not with settling policy questions. Congress has not yet indicated its desires on reimbursement of utilities relocation costs.

The questionnaire's 13 major questions ask for pertinent data on the nature of the utility replying, the highway projects involved, cost of relocation, costs reimbursed by state or other political subdivisions, and nature of rights-of-way involved.

Influential in drawing up the final form of the questionnaire were the following representatives at the Aug. 20 conference: Rural Electrification Administration, Edison Electric Institute, National Rural Electric Cooperative Association, American Public Power Association, Tennessee Valley Public Power Association, National Association of Railroad & Utilities Commissioners, Connecticut Light & Power Co, and Sam Houston Electric Cooperative.

MEETINGS CALENDAR

INTERNATIONAL ELECTROTECHNICAL COMMISSION
50th Anniversary Meeting, University of Pennsylvania, Philadelphia, Sept. 1-16.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS
Fall Meeting, Schroeder Hotel, Milwaukee, Sept. 8-10; Annual Meeting, Statler Hotel, New York, Nov. 28-Dec. 3.

MICHIGAN MUNICIPAL UTILITIES ASSOCIATION
Fall Conference, Petoskey, Mich., Sept. 8-10.

ROCKY MOUNTAIN ELECTRICAL LEAGUE
Annual Fall Convention, Stanley Hotel, Estes Park, Colo., Sept. 12-15.

ILLUMINATING ENGINEERING SOCIETY
National Technical Conference, Chalfonte-Haddon Hall, Atlantic City, N. J., Sept. 13-17; Pacific Northwest Region Conference, Harrison Hot Surings, British Columbia, Canada, April 25-26, 1955.

INSTRUMENT SOCIETY OF AMERICA
1st International Instrument Congress-Exposition, Philadelphia, Sept. 13-24.

PENNSYLVANIA ELECTRIC ASSOCIATION
47th Annual Meeting and Business Conference, William Penn Hotel, Pittsburgh, Sept. 14-15; Fall Meeting, Systems Operation Committee, Alexander Hotel, Hagerstown, Md., Oct. 7-8; Fall Meeting, Relay Committee, Hotel Alexander, Hagerstown, Md., Oct. 14-15; Fall Meeting, Electrical Equipment Committee, Hotel Robert Treat, Newark, N. J., Oct. 19-20.

PUBLIC UTILITIES ASSOCIATION OF VIRGINIAS
36th Annual Meeting, The Greenbrier, White Sulphur Springs, W. Va., Sept. 16-18.

EDISON ELECTRIC INSTITUTE
Commercial Section Committee Meetings: Commercial Electrical Space Heating and Air-Conditioning, Commercial Lighting, Commercial Cooking. All to be held at EEI Headquarters, New York, Sept. 2-3; Street Lighting Committee, Haddon Hall, Atlantic City, Sept. 15; Industrial Power and Heating Section Committee Meetings: General Power and Heating, Competitive Service, and Industrial Sales Methods and Development. All to be held at EEI Headquarters, New York, Sept. 16-17; Farm Section Committee Meetings: Agricultural Development, Farm Sales Promotion, Farm Utilization, Rural Youth. All to be held at Roosevelt Hotel, New York, Sept. 16-17; Dealer Co-ordination Committee Meeting, EEI Headquarters, New York, Sept. 16-17; Accident Prevention Committee, Benjamin Franklin Hotel, Philadelphia, Sept. 20-21; Residential Promotional Committee Meeting, EEI Headquarters, New York, Sept. 27-28; Industrial Relations Committee, Round Table Conference, Palmer House, Chicago, Sept. 27-29; Meter and Service Committee, Leland Hotel, Springfield, Ill., Sept. 27-29; EEI-AGA Tax Committee, Brown Palace Hotel, Denver, Colo., Sept. 29-Oct. 1; Prime Movers Committee, De Witt Clinton Hotel, Albany, N. Y., Oct. 4-5; Area Development Workshop, Hotel Statler, Cleveland, Ohio, Oct. 7-8; Transmission and Distribution Committee, Sir Francis Drake Hotel San Francisco, Calif., Oct. 7-8; Electrical Equipment Committee, Hotel Statler, Hartford, Conn., Oct. 11-12; Commercial Division General Committee Meeting, EEI Headquarters, New York, Oct. 15; Industrial Relations Committee, in conjunction with North Central Electrical Association, Minneapolis, Minn., Nov. 18-19; Prime Movers Committee, Astor Hotel, New York, Nov. 29-30; Sales Conference, Edgewater Beach Hotel, Chicago, March 28-31, 1955; Annual Convention, Statler-Biltmore Hotels, Los Angeles, June 13-16, 1955.

MISSOURI VALLEY ELECTRIC ASSOCIATION
Accounting Conference, Jefferson Hotel, St. Louis, Mo., Sept. 23-24; Sales and Rural Conference, President Hotel, Kansas City, Mo., Oct. 6-8; Industrial and Commercial Sales Conference, President Hotel, Kansas City, Mo., Feb. 3-4 1955; Engineering Conference, President Hotel, Kansas City, Mo., March 23-25, 1955.

SOUTHEASTERN ELECTRIC EXCHANGE
Engineering and Operation Section, Thomas Jefferson Hotel, Birmingham, Ala., Sept. 23-24; Accounting Section, Roanoke Hotel, Roanoke, Va., Oct. 21-22; General Sales Conference, Roosevelt Hotel, New Orleans, La., Oct. 28-30; Accident Prevention Committee, Heidelberg Hotel, Baton Rouge, La., Nov. 11-12; Annual Meeting, Boca-Raton Hotel and Club, Boca Raton, Fla., March 21-23, 1955; Engineering and Operation Section, Roosevelt Hotel, New Orleans, La., April 7-8, 1955.

ATOMIC INDUSTRIAL FORUM, INC.
Meeting on "What the New (Atomic) Law Means", Hotel Plaza, New York, Sept. 27-28; Meeting in conjunction with New England Council, Statler Hotel, Boston, Oct. 20.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS
Committee on Petroleum, Conference on Electrical Applications in Petroleum Industry, Mayo Hotel, Tulsa, Okla., Sept. 27-29; Middle Eastern District Meeting, Abraham Lincoln Hotel, Reading, Pa., Oct. 5-7; Fall General Meeting, Morrison Hotel, Chicago, Oct. 11-15; Winter General Meeting, Hotel Statler, New York, Jan. 31-Feb. 4, 1955.

INSTITUTE OF RADIO ENGINEERS
Professional Group on Industrial Electronics and Pittsburgh Section of IRE, Symposium, Mellon Institute, Pittsburgh, Pa., Sept. 29-30.

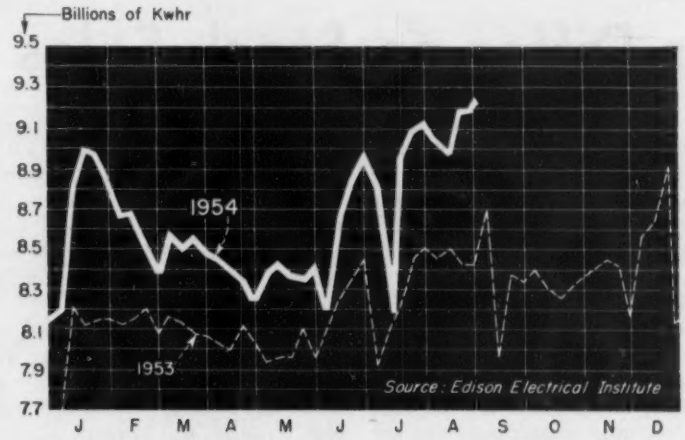
INTERNATIONAL ASSOCIATION OF ELECTRICAL LEAGUES
19th Annual Conference, Bellevue-Stratford Hotel, Philadelphia, Sept. 29-Oct. 2.

NATIONAL ELECTRONICS CONFERENCE
10th Annual Conference, Hotel Sherman, Chicago, Oct. 4-6.

NATIONAL ASSOCIATION OF ELECTRICAL DISTRIBUTORS
Pacific Zone Convention, Mark Hopkins Hotel, San Francisco, Oct. 4-7.

(*Continued on page* 148)

STATISTICS



Output Week Ended Aug 28—9,227,000,000 Kwhr

Per Cent Change From Previous Year

	Total US	New Eng.	Mid. Atlan.	Cent. Ind.	West Cent.	South-east	South Cent.	Rocky Mount.	Pacific NW	Pacific SW
Aug. 28	+8.0	−0.4	0.0	+1.0	+7.3	+20.3	+22.2	−0.3	+2.2	+3.5
Aug. 21	+9.2	+1.8	+2.8	+0.7	+11.3	+20.4	+24.5	+1.8	+2.8	+2.4
Aug. 14	+5.7	−0.4	−0.2	−4.2	+5.1	+17.4	+14.5	+4.7	+1.9	+3.1

Seasonally Adjusted Index† 176.4 Week Ago 176.4 Year Ago 163.2

Electric Power Statistics

		Latest Month	Preceding Month	Year Ago
Peak Load‡ (Million Kw)	June	78.0	73.8	73.0
Capacity (Million Kw)	June	95.31	93.81	85.06
Production (Billion Kwhr)	June	38.90	37.43	36.98
Hydro	June	9.59	10.35	9.10
Fuel	June	29.31	27.08	27.88
Fuel Consumption				
Coal (Million Tons)	June	9.29	8.67	9.07
Oil (Million Barrels)	June	4.29	4.25	6.11
Gas (Billion Cu Ft)	June	107.79	94.70	103.73
Sales (Billion Kwhr)	June	32.57	31.59	31.77
Residential	June	9.32	9.31	8.37
Commercial	June	6.04	5.62	5.46
Industrial	June	14.85	14.43	15.80
Other	June	2.36	2.23	2.14
Net Income Class A & B Companies ($ Million)	May	85.46	96.05	82.58
Estimated Dec. '54 Peak ‡(Million Kw)	May	88.1	88.4	91.8
Kwhr per Residential Customer (12 Month Average)	June	2,441	2,427	2,256
Revenue per Kwhr Residential Service (12 Month Average)	June	2.71¢	2.72¢	2.76¢
Canadian Production (Billion Kwhr)	June	5.67	5.93	5.26

Business Statistics

FRB Industrial Production Index†	July	117*	124	129
Gross National Product Annual Rate ($ Billion)	2nd Qtr.	356.0	355.8	369.9
EW 4 Industry Production Index†	May	114.9	114.6	126.2
ENR Construction Cost Index††	July	135.0	130.5	126.6
BLS Consumer's Price Index	June	115.1	115.0	114.5
NEMA Insulation Materials Sales Index†	June	124	116	174
NEMA Electric Appliance Sales Index†	June	102	89**	105
NEMA Household Refrig. Sales Index†	June	82	74	88
Metal Prices (Aug. 25)				
Copper, Conn., V., lb		$.29¾	$.30	$.29½
Lead, N. Y., lb		.14¼	.14	.14
Zinc, prime Western E. St. Louis, lb		.11	.11	.11
Tin, Straits, qual. N. Y. lb		.93¼	.93½	.83
Aluminum, ingot, base price		.21½	.21½	.21½
Nickel, base price		.60	.60	.60
Steel, billets, Pitts., ton		64.00	64.00	62.00
Steel, scrap, No. 1 heavy, Pitts., ton		29.00	28.00	44.00

*Preliminary **Revised ‡Class 1 Systems †1947-49=100 ††1949=100

People on the Move— In One State; Out Another

From time to time the Census Bureau analyses the shifts in population from state to state and in and out of the country. This "migratory" analysis is by far the most effective factor influencing individual state populations —over and above the birth and death rates in each. More than that, it indicates just where new population centers are rising and what the trends are in relation to agricultural and industrial areas.

In war-time, for example, there is always an increased migration from farming areas to industrial ones. The Korean war was the most recent illustration of this, and with its end, there has already been a slackening in this movement.

Climate Appeal . . . A less grim phenomenon in population growth by states is that due to the appeal of climate making some of them increasingly attractive from standpoints of health, retirement, and recreation. A few have seen particularly rapid growth in the past few years, and with the exception of Florida, all are in the southwest: Cal., Ariz., and Nev.

Five out of the 44 states that gained in population between 1950 and 1953, including the District of Columbia, gained over half their increases as a result of net total in-migration (which also includes movements of armed forces personnel). In the 5 states that lost population, the net total of residents leaving the state exceeded the natural increase. These include Maine, New Hampshire, Iowa, West Virginia and Arkansas.

Declining Rural Areas . . . Although only those five declined in total population, there were 29 states, including the District of Columbia, where migration out of the state exceeded migration into the state. The majority of these (17) were states that were predominantly rural in population makeup. Five others had only slightly less than 50% of their total population rural. The remaining states although not following this rural-out-migration pattern had relatively smaller net total out-migrations.

States with a net in-migration were those in which more than half the population was living in urban areas.

Finance Groups Differ on Stock Sales

Whether or not to sell electric utility stocks in the present high market is controversial according to at least two financial houses. Goodbody & Co believes that the stocks should not be sold if they were purchased for income and long term growth. Josephthal & Co, on the other hand, believes the electric utility stocks are "overpriced and should be sold."

In its Research Bulletin dated Aug. 19, 1954, Goodbody recommends that electric utility stocks "should be retained" if held for income purposes even though the market is high. This particularly applies if stocks were purchased at a low level.

Goodbody points out that if its customers "sold they would have to pay 25% of their profits" as capital gains "and put the balance of the proceeds in something else. We have found it more and more difficult to find utility stocks that we could recommend for purchase."

Utility Stocks Dip Less . . . If they sell and "wait for a break in the utility market," Goodbody said, they will lose income. "Utility stocks generally decline less and at a slower pace than industrials in a market decline.

"It is quite possible that utility stocks might sell 10% or even 20% lower in the next 18 months if the general market were to decline sharply. It is also quite possible that many of them may sell 10% lower before they sell 10% higher. But selling utility stocks on the theory that one can replace them cheaper involves a loss of income and loss of a lower cost figure."

Another reason for retaining electric utility stocks, the company said, "is that the growth of the industry is so consistent that even though many utility stocks now seem high priced, the development of higher earnings over a period of time should justify present prices and considerably more eventually. True some utility companies had to grow in earnings for five or six years after 1946 to justify the 1946 highs in their stocks and this could occur again."

"But if utility stocks do sell lower in the next year or two, as they might, they would be more attractive for yield purposes and most institutional buyers and many individuals might be better off to average down . . . rather than to sell now, pay 25% taxes and hope to get in again at lower levels."

Opposing Theory . . . Josephthal & Co, however, has reached the opposite conclusion. In its special bulletin dated Aug. 12, 1954, it said: "By any standard, utility stocks are too high and . . . entail market risks that are not justified by either present or prospective earnings and dividends or by possible further appreciation possibilities."

The company bases this on its findings that electric utility stock prices are "higher in relation to dividends and earnings than at almost any time in the past nine years."

"At the present time," Josephthal said, "Moody's weighted average of 24 electric utility stocks is selling 16.5 times earnings and affords a return of only 4.55%. Since the end of last year the market value of these stocks has risen 17.4% while dividends and earnings have increased only 1.9% and 1.8%, respectively. Compared with June of last year when the market reached its low, prices have advanced 34% while dividends and earnings have increased only 6.5% and 1.4% respectively.

"In January, 1946, the yield on Moody's weighted utility average was as low as 3.84% and the price was 20.8 times earnings, but at that time both dividends and earnings reflected the heavy burden of 1945 excess profits taxes and were obviously headed for substantial increases. In fact, dividends in 1946 increased 8% while earnings were 27% larger than those reported for 1945. But even with these sharp increases, which certainly are not in prospect at the present time, the market could not maintain such high levels and in the fall of 1946 precipitously started a 29% decline."

The report concludes with a statement that "utilities are overpriced and should be sold."

Hits Georgia Power Refinancing

Georgia Power Co's plan to reissue its $6 preferred stock at a lower dividend rate has run into some heavy weather. Walter B. McDonald, member of the Public Service Commission of Georgia, has issued warnings to the company that the exchange plan was moving ahead too fast. When the plan came up for public hearing last week there were indications that the commission would not consider it in the best public interest.

At issue was a proposal presented to the commission on Aug. 3 by the utility to refinance the company's 433,869 shares of $6 preferred stock outstanding by issuing an equal number of shares bearing a lower interest rate (EW, Aug. 16, p 63). Last issue of the company's preferred stock, sold in 1953, now pays a dividend of $4.92. Rate on the new preferred stock may be somewhere between $4.50 and $4.70, depending on market conditions.

Actually, Commissioner McDonald has no quarrel with the attempt to bring dividend rates into line with current market values.

Root of the trouble, according to McDonald, is the cost of conversion. The company plans on borrowing up to $3.5 million to refinance the stock and amortize that amount over an eight-year period. Any benefits to power users as a result of the refinancing program would be deferred until the loan is paid off.

In a letter to Georgia Power's Pres Harllee Branch, McDonald said that such a proposal "does not appear in the best public interest and it is subject to serious question." McDonald added: "The ostensible purpose, namely the reduction of cost of capital, is of course, laudable, but the necessity for the expansion and extravagant plan of conversion which you propose must be fully supported and justified."

The commissioner told Electrical World that the company's plan to have a syndicate handle the transaction was unnecessary. He said that in accordance with the company's charter, the conversion could be affected by merely giving notice to the $6 preferred holders that the board deems it necessary to convert the stock to a preferred stock bearing a lower dividend rate and asking that they forward their shares to a named registrar such as the Trust Company of Georgia or the First National of Atlanta. This would necessitate only the payment of a very small handling charge to the bank.

McDonald added that the company has already admitted that the vast majority of the $6-preferred holders would willingly turn in their shares for the new issue, thus avoiding the $3.5 million "incurred expenses."

McDonald's letter to Branch was an almost unprecedented move. It came just as the company was marshalling its big guns for the public hearing set for this week. The commissioner asked the full PSC to approve his warning letter to the power company but got turned down. The commission agreed with McDonald's views in essence but felt that the wording was too strong to be an official expression. Thus, McDonald sent the letter over his own signature.

Branch declined to go into details in his response to McDonald. He held simply that the reissue plan was in the best interests of the company's half million customers as well as that of the investors.

FINANCIAL BRIEFS

Detroit Edison Co has inaugurated an employee stock purchase plan providing for deductions of up to 10% of base wage for purchasing stock on open market.

Kansas Gas & Electric Co has increased its annual common stock dividend from $2 to $2.40 . . . **Florida Public Utilities Co** has been granted state permission to float a $500,000, 30-year bond issue at 3.75% interest.

Ohio Power Co has applied for Securities & Exchange Commission approval to acquire the Bluffton, Ohio, electric system (EW, Aug. 23, p 89).

Today in Utility Finance

YIELDS (%)

Quality	Bonds			Preferred Stocks			Common Stocks		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
DATE									
Aug. 26	**2.86**	**2.90**	**3.11**	**3.95**	**4.06**	**4.42**	**4.47**	**4.83**	**5.09**
Aug. 19	2.85	2.90	3.11	3.95	4.06	4.42	4.48	4.74	5.03
END OF QTR.									
2nd 1954	2.90	2.96	3.19	4.03	4.14	4.48	4.72	5.04	5.45
1st 1954	2.82	2.87	3.14	3.88	4.00	4.42	4.83	5.19	5.42
4th 1953	3.07	3.12	3.34	4.17	4.32	4.62	5.07	5.57	5.51
3rd 1953	3.30	3.33	3.54	4.35	4.52	4.83	5.36	5.57	6.01

Data: Reis & Chandler, Inc.

EARNINGS

Company	Period Months Ended		Net Income 1954	Net Income 1953	Earnings Per Common Share 1954	Earnings Per Common Share 1953
Alabama Power	12	July	$13,061,626	$12,432,102	....	....
Arkansas-Missouri Power, consolidated	12	June	875,359	.....	....	....
Arkansas Power & Light	12	July	6,480,569	6,002,498	....	....
Central Illinois Light	12	July	3,473,832	3,419,320	2.97(a)	3.24(a)
Central Vermont Public Service, consolidated	12	July	1,135,227	1,006,899	1.03(b)	1.05(b)
Georgia Power	12	July	13,216,594	12,189,081	....	....
Houston Lighting & Power	12	July	11,539,913	9,909,526	2.11(c)	1.91(c)
Idaho Power	12	June	4,602,176	4,291,491	3.43	3.17
Michigan Gas & Electric	12	June	416,760	392,188	2.98	2.80
New Jersey Power & Light	12	June	1,699,842	1,217,862	....	....
Ohio Edison and subsidiary	12	July	19,740,061	18,067,528	2.93(f)	2.97(f)
Oklahoma Gas & Electric	12	July	5,998,377	6,053,375	1.86(g)	1.95(g)
Pennsylvania Power	12	July	2,575,820	2,295,136	....	....

Notes—(a) Based on 1,000,000 shares in 1954 and 900,000 shares in 1953; (b) Based on 867,141 shares in 1954 and 771,037 shares in 1953; (c) Based on shares outstanding at close of respective periods; (f) Based on 5,806,136 shares in 1954 and 5,278,306 shares in 1953; and (g) Based on 2,653,140 shares in 1954 and 1953.

FINANCING

Company and Description	Amount of Offering ($000)	Offering Price	Yield to Public
WEEK OF AUG. 26–SEPT. 1			
Common Stock			
California Electric Power—170,000 sh	$2,006	$11.80	5.08%
SCHEDULED FOR SEPTEMBER—OCTOBER			**Bid Date**
Bonds and Debentures			
Los Angeles, Calif., Department of Water and Power—electric revenues due 1955–84	$19,500	.....	Sept. 8
Montana-Dakota Utilities—1st mtg due 1979	5,000	.....	Sept. 8
Montana-Dakota Utilities—1st mtg due 1975	7,000	.....	Sept. 8
Dayton Power & Light—1st mtg due 1984	15,000	.....	Sept. 22
Northern States Power (Minn.)—1st mtg due 1984	20,000	.....	Sept. 28
Vineland, N. J.—electric plant due 1955–74	3,500	.....	Sept. 28
Columbus & Southern Ohio Electric—1st mtg	10,000	.....	Sept. 29
Public Service Co of Colorado—1st mtg due 1984	20,000	.....	Oct. 4
Indiana & Michigan Electric—1st mtg due 1984	16,500	.....	Oct. 5
Wisconsin Power & Light—1st mtg	18,000	.....	Oct. 5
Sierra Pacific Power—1st mtg	4,000	.....	Oct. 8
Texas Power & Light—1st mtg 1984	20,000	.....	Oct. 18
Louisiana Power & Light—1st mtg 1984	17,000	.....	Oct. 20
Savannah Electric & Power—1st mtg	5,000	.....	Oct. 26
Savannah Electric & Power—debs	3,000	.....	Oct. 26
Cleveland, Ohio—electric revenues	5,000	.....	.....
Western Massachusetts Electric	6,000	.....	.....
Preferred Stock			
Oklahoma Gas & Electric—75,000 sh $100 par	$7,500	.....	Sept. 14
Illinois Power—180,000 sh $50 par	9,000	.....	Sept. 15–16(a)
Tampa Electric—50,000 sh $100 par	5,000	.....	Sept. 22
Indiana & Michigan Electric—40,000 sh $100 par	4,000	.....	Oct. 5
Savannah Electric & Power—30,000 sh $100 par	3,000	.....	Oct. 26
Georgia Power—433,869 sh no par (to be offered in exchange for outstanding $6 pfd on a share-for-share basis, plus $5 in cash and accrued dividends)	.....	.....	.....
Common Stock			
Illinois Power—200,000 sh	.....	.....	Sept. 15–16(b)
Columbus & Southern Ohio Electric—200,000 sh	.....	.....	Sept. 20(c)
New England Electric System—910,833 sh $1 par to be offered commonholders on a 1-for-10 basis, record Sept. 29)	.....	.....	Sept. 28
San Diego Gas & Electric—800,000 sh $10 par (to be offered commonholders on about 1-for-4 basis, record of Sept. 14)	.....	.....	.....
Sierra Pacific Power—34,807 sh (to be offered commonholders, record about Oct. 6 to expire Oct. 22)	.....	.....	.....
ISSUES RECENTLY POSTPONED			
Bonds			
Gulf States Utilities—1st mtg due 1984	$24,000	.....	.....
Consolidated Edison Co of N. Y.—1st mtg due 1984	50,000	.....	.....
Preferred Stock			
California Electric Power—105,000 sh $50 par	$5,250	.....	..... (f)
Gulf States Utilities—160,000 sh $100 par	16,000	.....	.....

Notes—(a) Merrill Lynch, Pierce, Fenner & Beane group, underwriters; (b) First Boston—Merrill Lynch; (c) Dillon Read & Co, Inc, group, underwriters; (f) Temporarily postponed.

WASHINGTON COMMENT

JESSE MOCK

Preference clauses written into the new atomic energy law promise to be as much a center of conflict as those found in water power legislation.

Public power, labor and some farm groups backing preference are still not certain that the provisions will give public power and rural electric cooperatives the advantages they are seeking.

Preference issue stirred up anew by atomic law

Sharp differences over these clauses were largely responsible for Senate rejection of the first conference report on the legislation. Public power advocates, who wrote the preference provisions, threatened to scuttle the whole bill or delay adjournment of Congress unless the preference admendments remained in.

Thus, the public power lawmakers will be out to protect these provisions which they consider their major accomplishment during the past session of Congress. And the lobbying groups will be back of them as the law is translated into Atomic Energy Commission regulations and later administered.

Private Power Defers Comment . . . Private power spokesmen have had little to say on the preference provisions thus far, but will present their views at rule-making hearings to be conducted by AEC. Since electric companies have a larger stake in development of economic nuclear power than will the public groups, they will want the rules drawn to minimize disagreement over the preference clause.

Skeptical observers pooh-pooh the whole preference fight over the new law. They argue that these clauses are mere rules for slicing a pie which does not exist. The energy spent in making the preference fight, the skeptics say, would be better used to develop economical nuclear power—the pie the public power advocates are so eager to slice.

First of the preference provisions, found in Section 44 of the new act, relates to the disposal of surplus electric power from AEC experimental or production facilities. The second, found in Section 183 C, relates to the issuance of licenses for commercial power plants. The remainder of this column deals with the first preference provision, leaving the matter of preference in the issuance of licenses for discussion in a later issue.

Section 44 of the act spells out criteria for disposing of heat and electrical energy from AEC production or experimental facilities. It provides that energy other than electric power "may be used by AEC, or transferred to other government agencies, or sold to publicly, cooperatively, or privately owned utilities or users at reasonable and nondiscriminatory prices."

Different rules are drawn up for disposal of surplus electric energy. Rates are subject to regulation by the agency—state or federal—having jurisdiction. The preference is contained in this sentence: "In contracting for the disposal of such energy, the commission shall give preference and priority to public bodies and cooperatives or to privately owned utilities providing electric utility services to high cost areas not being served by public bodies or cooperatives."

No Preference in Sale of Steam . . . Applying this section to the utlity-size, pressurized water reactor (PWR) which Westinghouse and Duquesne are to build near Pittsburgh, we get the following results: AEC is sponsoring the PWR project on the experimental basis and putting up most of the money for it. However, its contract with Duquesne calls for sale of steam—not electrical energy. Thus the preference does not apply.

Suppose, now, that AEC was to sell electric power from the Duquesne plant and there were preference customers in the area. Under the law, they would get first call on it.

There is one other factor in the AEC-Westinghouse-Duquesne project: The contract is already signed and the new law makes no provision for negating existing contracts.

Now let's apply Section 44 to another possible situation. Suppose AEC adopts General Electric Co's plan for generating around 500,000 kw of electric energy from the Hanford, Wash., plant.

If AEC finances the whole project, including the electrical generating facilities, it would appear that public bodies and cooperatives would have first call on all power in excess of AEC and other federal needs. On the other hand, if private interests bought only the heat or steam from the Hanford plant, the power would be transmitted and sold in accordance with regular private utility practices.

One effect of this preference provision, then, may be to bring in more private capital on experimental projects in order to protect the power marketing patterns established in the project areas.

TECHNICAL NOTES

ARCHER E. KNOWLTON

Power transfer ability of a 138-kv line with 75% inductive compensation is approximately equal to that of a 220-kv line without compensation, similarly for 220 and 345 kv.

Transformers fabricated in Austria, Belgium, France, Germany, and Italy during World War II were wound practically exclusively with aluminum conductors.

System losses for a given load decrease as the square of voltage increases. Therefore for efficiency keep the voltage as high as is feasible.

Cooling towers involve inherent dispersal of equipment relative to the power plant and may, unless care is exercised in design and layout, incur increased plant labor costs.

Phosphate glass will fluoresce after exposure to nuclear radiation. The material, therefore, has value for detecting degree of personal exposure.

Higher specific speed of hydro turbines may reduce generator costs but may also require a lower setting and thus incur offsetting costs.

Pyrites appear to be the main source of formation of deposits on heat-absorbing surfaces of boilers.

Long Island Lighting Co Substations Get Beauty Treatment

WILLIAM McCONNACHIE, Ass't Electrical Planning Engineer, Long Island Lighting Co, Mineola, L. I.

Attractive landscaping is now an integral part of substation design at Long Island Lighting Co. Substations are built to harmonize so well with surroundings that they help beautify them. The company willingly accepts the cost as the price of locating substations near load centers to achieve economical distribution. Specifications set by the Municipal Relations, Operating, and Engineering Departments include:

1. Location and size of the site.
2. Selection of open or enclosed high-voltage switching structure.
3. Provision for sound barriers where need can be anticipated.
4. Extent of underground distribution and transmission cables.
5. Type of landscaping and fences. Use of existing trees is a major factor.

Story continues on next page

Continued from preceding page

Substation sites like this . . .

Landscaping is planned by a committee of three, an architect, nurseryman, and the design engineer. Approved preliminary plan (left) and elevation drawings of the substation (in this case Smithtown) are checked against field conditions at and near the site. Photographs (above) are taken of the site to guide preparation of a detailed landscaping plan and perspective drawings.

TREATMENT OF SMITHTOWN SUBSTATION (above) SHOWS HOW LONG

The species and initial size of shrubs and trees used are selected for hardiness and ease of maintenance as well as appearance. Many varieties are used, but the majority are evergreens because they provide year-round screening. These include black and white pines, Japanese boxleaf, American holly, inkberry, spruce, hemlock, yew, and barberry. Flowering varieties include dogwood, mountain laurel, Azalea, and roses. Decidious trees include pin oaks, Russian olive, red maple, and ginko. Wherever possible existing trees are retained and others, along with shrubs, are added so as to blend into an attractive setting.

Ground covers such as pachysandra, myrtle, laurel, and honeysuckle are used as well as grass. Split rail or stockade fences supplement the planting which is generally in the area outside the chain link fence surrounding the substation equipment.

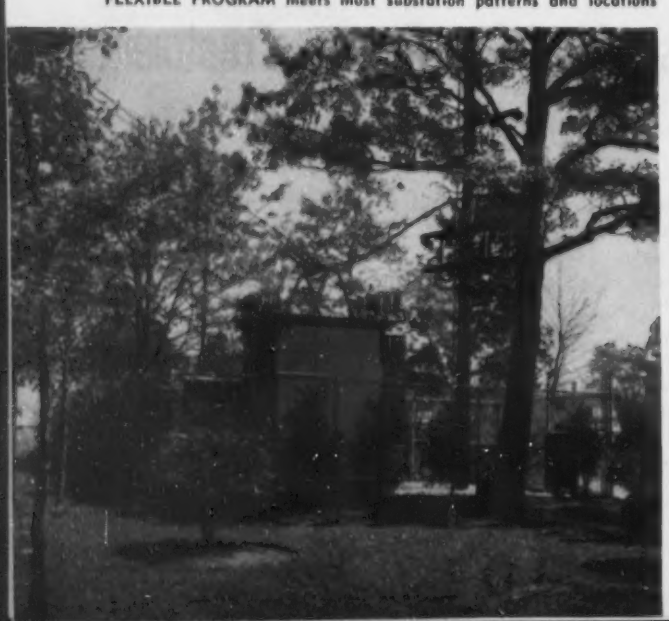
Preliminary to planting the soil is fertilized, and if necessary top soil is added. A water supply is provided so that the plantings can be watered as needed.

Initial cost varies with the size of the substation, its structures, and the site location. The actual cost for landscaping 12 typical distribution substations in 1950-53 was $32,500, an average of $2,700 per station. Costs ranged from $1,100 for a 1,500-kva, 23-4-kv single-circuit substation to about $5,000 for a 20,00-kva, 66-13-4-kv installation. This represents an average of 1.9% of total station cost, ranging from .7% for 20,000 kva to 5.3% for 1,500 kva.

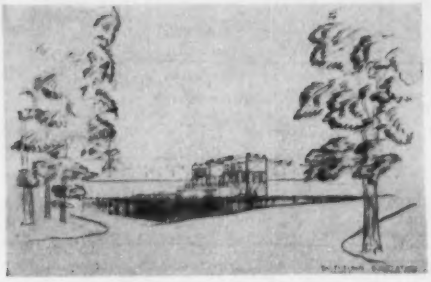
Cost per kva of initially installed capacity averaged 60¢. This will be reduced to 38¢ per kva when these stations reach their maximum capacity. The range will then be 16 to 98¢ per kva. Average cost per lineal landscaped foot measured at the fence line was $15. Costs ranged from $8.66 to $29.81 per ft. Average cost per 100 sq ft of area enclosed by the fence was $50.50, ranging from $32 for 20,000 kva to $197 for a 1,500-kva unit.

Regular maintenance is a must to make the landscaping program effective. With proper care the shrubs, trees, and lawns become even more attractive. To this end the substation section was expanded by five two-man crews

FLEXIBLE PROGRAM meets most substation patterns and locations



. . . are landscaped like this



Landscaping is added to the perspective drawings (left) according to detailed plan shown below. When the plan has been approved, the site is planted in keeping with it. Final accomplishment is recorded by photographs (above) and colored slides which with the initial pictures, drawings, and cost estimates complete the project record for the company files.

ISLAND LIGHTING BEAUTIFIES SURROUNDINGS AT REASONABLE COST

trained by a professional gardener and nursery man. In addition to maintaining the new substations, these men also work to improve the appearance of older substations.

Annual cost of maintaining the 12 typical substations is about $11,500 annually. Of this total $900 is for transportation of labor and for tools. Another $900 goes for plant food, sprays, and weed killer. The remainder, $9,700, takes care of labor, an estimated 3,215 manhours, and overhead. Average annual cost is approximately $960, the range from $540 to $2,075 per station.

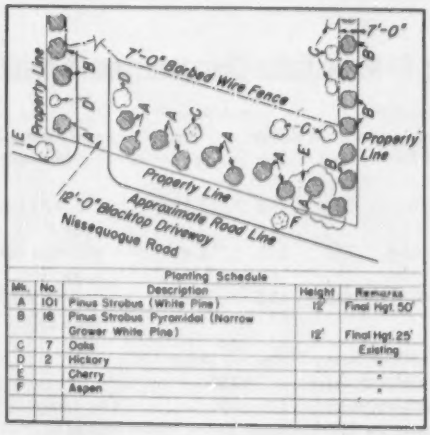
Average maintenance cost per lineal landscaped foot measured at the fence line was $5.27. And the average cost per 100 sq ft of enclosed area was $17.76. Records of these costs are kept for each substation.

This policy of station beautification marks a distinct change from substation design practice prior to 1946. Then appearance posed no special problems. Many stations were located in industrial or business areas. Those near residential areas were enclosed in attractive brick buildings. Older cement-block buildings were painted with a gray-green waterproof paint. Grounds surrounding them were planted with grass and a few shrubs. Maintenance was a part-time activity of a few crews which devoted most of their time to "important" work.

By 1947 the postwar building boom was in full swing. Approximately 30,000 homes a year have been connected since that time. Many new substations have been necessary to provide proper service. Because these new residential areas are so widespread, some substations must be located in them.

This created a public relations problem. The company could not install substations which were eyesores or unacceptable to the people living in these communities when modern factories and commercial buildings, with pleasing architectural lines, were being erected on well kept and artistically landscaped grounds. Long Island Lighting executives felt that the company had to set a high standard in erecting facilities as well as in providing service. They felt the company should lead rather than follow a trend. With this in mind substation beautification was adopted as a "Service to the Community."

LANDSCAPING PLAN for Smithtown substation shows what to plant



Planting Schedule

Mk.	No.	Description	Height	Remarks
A	101	Pinus Strobus (White Pine)	12'	Final Hgt. 50'
B	18	Pinus Strobus Pyramidal (Narrow Grower White Pine)	12'	Final Hgt. 25'
C	7	Oaks		Existing
D	2	Hickory		"
E		Cherry		"
F		Aspen		"

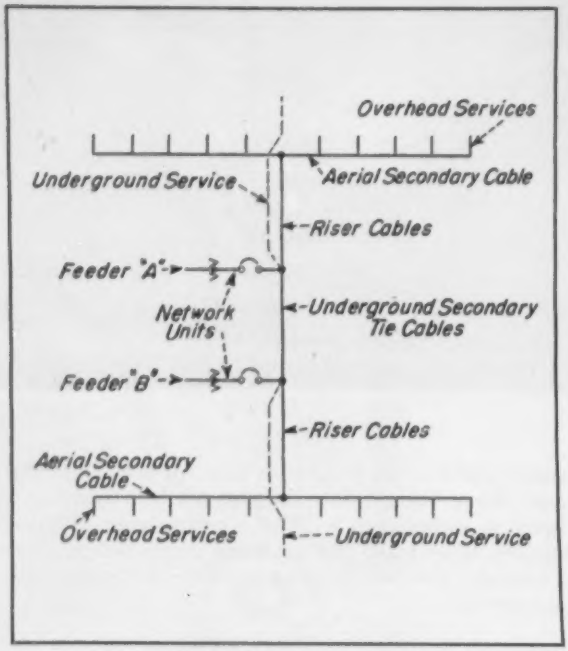


FIG 1A—INITIAL NETWORK can be two units in vaults, joined by underground tie and feeding aerial cable mains to overhead services

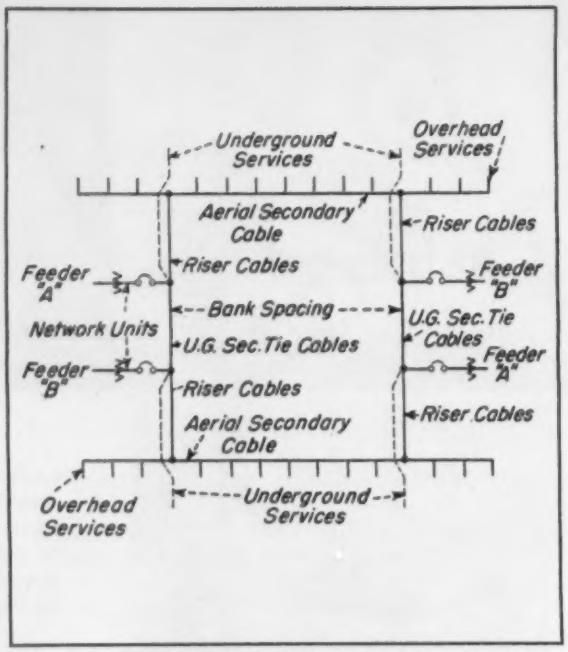


FIG 1B—NETWORK EXPANSION is by duplicating initial pair at another location up to 800 ft. Aerial cable mains tie the network pairs

Network with Vaults, Aerial Cable

F. C. VAN WORMER
N. M. NEAGLE, General Electric Co, Schenectady, N. Y.

Secondary networks with units in underground vaults and aerial-cable secondaries along the street can solve the distribution problems in small business districts. For the downtown section of small and medium-sized cities and for the outlying shopping centers around metropolitan areas such combined light-and-power networks minimize the congestion of conventional overhead service. Moreover, this system facilitates conversion to underground network if future growth demands removal of poles and wires.

Traditionally, these small business areas generally are supplied from 4-kv overhead radial feeders with separate power and lighting transformers, secondaries, and services. Many buildings require both power and lighting services. Over the years, increasing load has required more and larger transformers at closer spacing. Pole congestion and the maze of overhead

Table I—Aerial Cable Characteristics, 3-Phase Secondary

Cond Size	Circuit Rating Amp	Circuit Rating Kva	Circuit Impedance	Special Copperweld Messenger	Ultimate Strength lb	60F Sag in 100-ft Span
No. 4/0	245	92	7.65%	No. 1/0 Equiv Type K	14,490	0.93 ft
350 MCM	333	125	5.42%	No. 4/0 Equiv Type G	15,640	1.39 ft
500 MCM	408	153	4.48%	250 MCM Equiv Type EK	17,840	1.65 ft

3–1/c–600-v, heavy Neoprene jacket
Max conductor temp 75C
Max ambient temp 40C
Impedance on 500-kva base, 216 v, 100-ft lengths

Table II—Underground Cable Charac-

Cond Size	Number of 1 Circuit Rating Amp	Circuit Rating Kva
No. 4/0	282	106
Twin–4/0	450	168
350 MCM	384	144
500 MCM	468	175

1/c—heavy Neoprene jacket
Max conductor temp 75C
Max earth ambient 20C
Load factor 50%

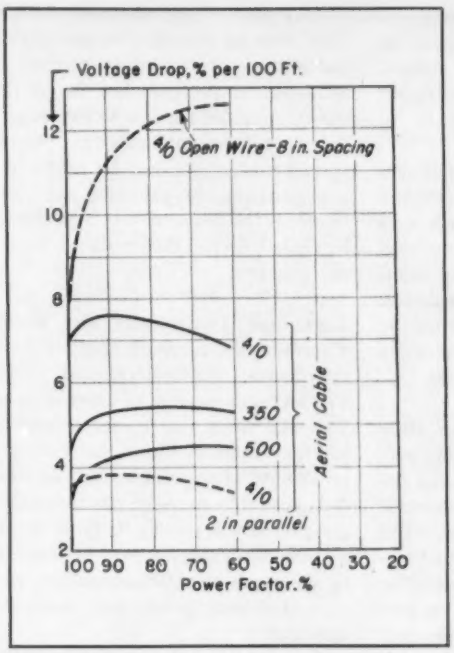


FIG 2—VOLTAGE DROP of aerial cable secondaries is less than open wire and little affected by load pf

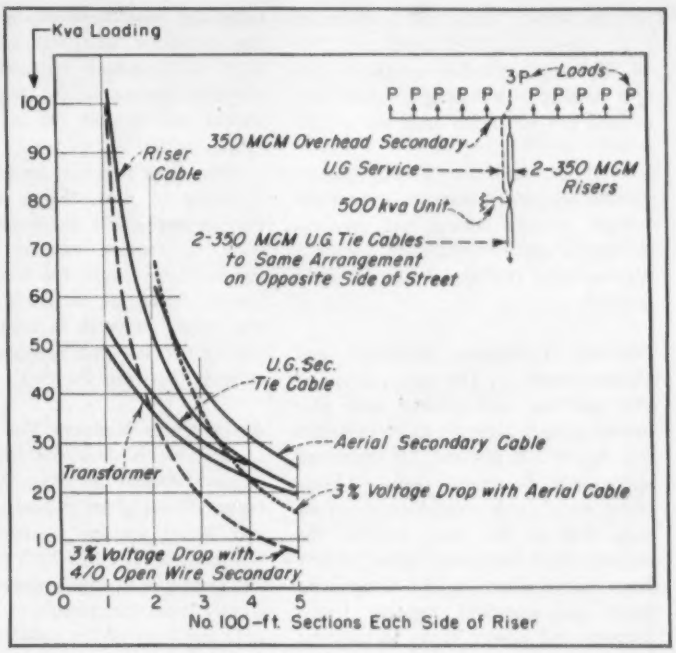


FIG 3—NETWORK LOAD CAPABILITY is limited by voltage drop for more than three 100-ft sections. But these give good balance, overload transformers but slightly

Serves Medium Load Densities

wires not only impede pole replacement and maintenance but promote municipal demands for underground distribution.

Study Determines Solution . . . Long-range forecasts in many cases do not justify conversion to a completely underground secondary network capable of serving the high load densities of metropolitan areas. Continuing the existing system promises only more congestion.

One solution of the distribution problems in such areas is a secondary network with units in underground vaults and aerial cable secondaries on poles along both sides of the street.

Some of the highlights of this system are:—

1. Vaults are located directly in front of the largest loads with underground cable ties between vaults on opposite sides of the street.

2. Short underground services from the vault to nearby loads and riser cables feeding aerial secondary cables

teristics—3-Phase Secondary

Equally Loaded Circuits

2		3		
Circuit Rating Amp	Kva	Circuit Rating Amp	Kva	Circuit Impedance
272	102	262	98	7.97%
435	163	420	157	3.88%
369	138	355	133	5.86%
447	167	426	160	4.95%

Impedance on 500-kva base, 216 v, 100-ft lengths
Reactance increased 20% for random lay in fiber duct

Table III—Riser Cable Characteristics, 3-Phase Secondary

Cond Size	Cables per Conduit	Circuit Rating Amp	Kva	Circuit Impedance
No. 4/0	3	203	76	8.08%
Twin-4/0	6	340	128	3.92%
350 McM	3	274	103	6.02%
350 McM	3	336	126	5.12%

1/c-600-v, heavy Neoprene jacket
Max conductor temp 75C
Max ambient air temp 40C

Impedance on 500-kva base, 216 v, 100-ft lengths Reactance increased 20% for random lay in fiber conduit Reactance increased 50% for random lay in iron conduit Riser cable assumed 25% in iron conduit, 75% in fiber

for the other loads still remaining.

3. 500-kva network units and 350-MCM secondary cables produce a system capable of handling 25 to 50 kva of load per 100 ft on each side of the street.

4. If the need for a fully underground secondary network system develops, network voltage has been established, and the already installed underground equipment can be fully utilized.

Network Combines Overhead and Underground . . . The combination of overhead and underground cable secondaries with network units in vaults will satisfy the demand for improved appearance in many cases. Three-phase aerial cable secondary mains on each side of the street replace the separate light and power wires. A few large transformers in vaults eliminate many pole-mounted lighting transformers and power banks to improve greatly the appearance of the overhead system. Further improvement in appearance and reliability may be attained by using aerial cable for the primary feeders.

Choice of 500-kva network units in the vaults and 350-MCM cable for secondaries makes a system suitable to serve 25 to 50 kva per 100 ft on each side of the street. This is the load density range which is troublesome for an entirely overhead system. Typical arrangement is shown in Fig. 1A.

Vaults on opposite sides of the street should be tied together with underground cables. The network protectors then function to permit each unit to back up the other in emergency.

Secondary network operation requires an excess of transformer capacity with respect to the network load. This is necessary so that the loss of transformer capacity because of a fault on or maintenance of a primary feeder leaves sufficient capacity to carry the total load.

At least two primary feeders, each supplying one network transformer and protector unit, are required to start a secondary network system. Normal loading of the transformers should not exceed 50 to 75% of rating.

This initial step may be spread over a period of time. First, a 500-kva transformer could be installed in a vault to replace existing overhead transformers. Next, the second transformer could be similarly installed. The initial network is completed by adding two network protectors and a cable tie between the two vaults.

Aerial Cable Reduces Voltage Drop . . . Cable is desirable for the secondary because the close spacing between phases gives reduced reactance and better voltage regulation. The voltage drop at 80 to 90% power factor, as shown in Fig 2, does not differ greatly from the maximum drop possible for each of the cable sizes covered. Very little error is introduced if the effect of power factor is neglected and the maximum drop corresponding to percent impedance of the cable is used in all voltage calculations. This simplification is slightly on the safe side in voltage regulation studies involving loads which usually have power factors in the 80 to 90% range.

The voltage drop resulting from use of 4/0 open wire on secondary racks also is shown in Fig 2. Comparison of the curve for 4/0 cable with that for 4/0 open wire shows the greatly reduced voltage drop resulting from the close spacing of aerial cable. Table I lists circuit ratings and impedances for the common sizes of aerial secondary cables.

Messengers for aerial cables are usually selected on the basis of not exceeding 30% ultimate strength at 60F unloaded or 50% ultimate under design load conditions. With network secondaries it is usual practice to use a neutral having at least 50% conductivity of the phase conductor. This may be provided by paralleling the messenger with other neutrals if available on the pole line or by the use of special Copperweld messengers having higher conductivity. These special messengers may be used without resorting to excessive sags for spans on the order of 100 ft as shown in Table I despite their reduced breaking strength.

Cable and Transformer Size Easily Coordinated . . . With uniform load distribution, the underground tie of Fig 1A must be able to carry at least 250 kva when one feeder is out of service. Table II shows that two sets of 350-MCM secondaries will do this. It is desirable to make the tie underground. It will usually be fairly short, and the extra expense may be justified by the resulting stiffer secondary, less congested riser poles, and improved appearance.

Connections between the network unit and aerial cable secondary are made with cables in conduit up the riser pole. The run from the vault to the pole and the first 10 ft up the pole are usually in galvanized steel conduit for maximum physical protection. The remainder is usually in fiber or Transite conduit to keep grounds from the working area.

Table III lists circuit rating and percent impedance for several sizes of secondary riser cables. Although part of the cable is in underground conduit and part in exposed conduit up the pole, the ratings are based on exposed conduit. This is somewhat conservative because some heat is dissipated to earth by conduction down the galvanized steel conduit. There may also be some ventilation by natural draft from the vault through and out the top of the riser conduit, provided both ends are left open. Secondary neutrals, at least 4/0, should be installed in the same conduit with the phase conductors.

Riser cables must be capable of carrying 250 kva less the amount of load fed directly from the vault. Table III indicates that two sets of 350-MCM risers will satisfy this condition.

The overhead secondary will have to carry a little less than 125 kva. A 350-MCM aerial cable will do this; so the same size cable may be used for all parts of the network with 500-kva transformer units. It is an advantage to use just one size of cable if possible.

Table IV—Network Loading Capabilities

Bank Spacing Ft	4 Unit Network: No of 100-ft Sections Beyond Risers	4 Unit Network: Loading Kva per 100 ft	Expanded Network: Loading Kva per 100 ft
800	3	29.0	25.5
600	2	39.5	34.0
400	1	54.5	50.0

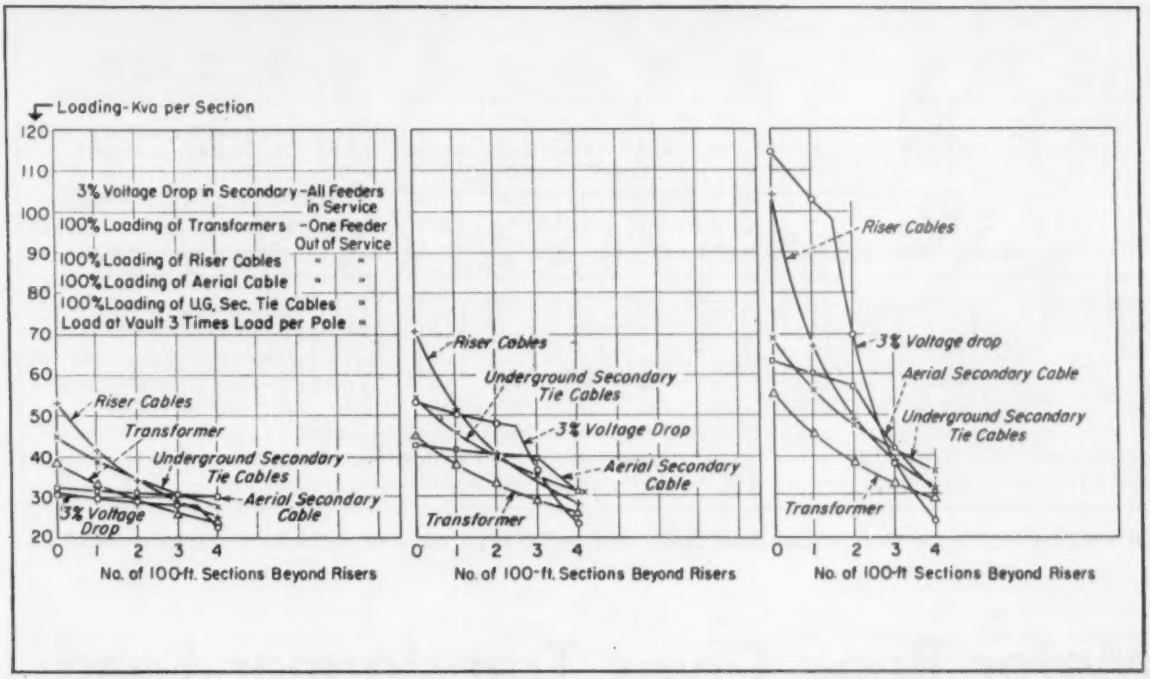


FIG 4—VOLTAGE DROP sets load limit for network pairs 800 ft apart as in Fig 1B

FIG 5—CUTTING SPACING to 600 ft shifts limitation to transformer loading

FIG 6—TRANSFORMER LOAD can be 120% at 400-ft spacing without overloading cable

500-Kva Units and 350-MCM Cables Suffice . . . Fig 3 illustrates the loading capabilities of 350-MCM secondaries and 500-kva network units. A 50-ft riser length, 100-ft sections between poles, and 100-ft underground secondary tie cables were assumed. In addition to the thermal limits of the secondary cables the following limits are also imposed:

1. Secondary voltage drop of 3% with both feeders in service.

2. With one feeder out of service the load on the remaining bank is not to exceed 500 kva.

With aerial cable secondary extended four or five sections on each side of the riser pole, the load per pole is limited by voltage drop. With three sections of secondary on each side of the riser pole, slightly overloading the transformer when one feeder is out permits the load to reach the thermal limit of the underground secondary tie cables without exceeding any of the other limitations. Load on the aerial cable can thus reach 31 kva per 100-ft section. Fig 3 also shows how 4/0 open-wire secondaries seriously restrict loading because of voltage drop.

The 500-kva network transformer unit and 350-MCM secondaries coordinate very well for three or four sections of overhead secondary extended on each side of the riser pole and are capable of handling loads in the order of 25 to 50 kva per 100 ft on each side of the street.

500-Kva Unit Is Preferred . . . Standard sizes of network transformers are 300, 500, 750, and 1000 kva. These are used with 1,200, 1,600, 2,500, and 3,000-amp network protectors. The 500-kva transformer and 1,600-amp protector comprise the majority of units in service today. Three reasons are:

1. The 500-kva unit has proved to be a flexible and economical building block for commercial areas. It is not too large a size to lose during an outage and not big enough to require excessive secondary cable to carry power to the load.

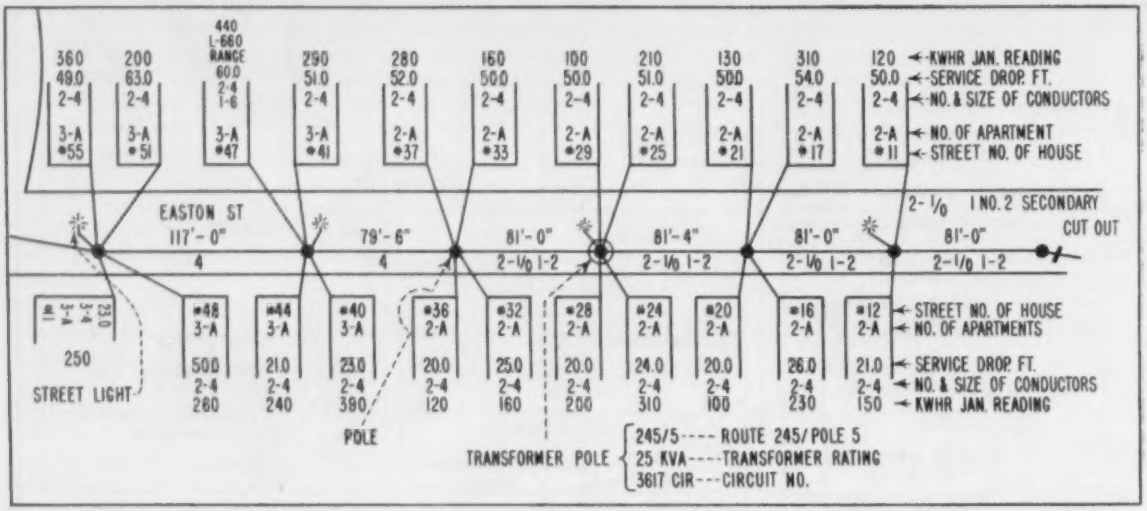
2. Network equipment follows the usual economic trend in that the larger the size, the lower the cost per kva. The largest reduction in dollars per kva is made in going from the 300-kva to the 500-kva size.

3. Space requirement for the 500-kva unit is practically the same as for the 300-kva unit.

Expansion Is Orderly . . . Once the secondary network is started with 500-kva network units and 350-MCM secondaries, it may be expanded by adding two more network units and connecting the two sets together as shown in Fig 1B. Spacing between units along the street is influenced by the locations of large blocks of load and the size of the load per section to be served.

The effect of bank spacing on the loading capabilities of the network is shown in Figs 4, 5, and 6 for 800, 600, and 400-ft separations. These are useful guides in planning a secondary network system. They show the limitations to be considered and how the relative importance of each changes with respect to unit spacing and the number of sections of aerial secondary. They also show that the network system is feasible in the loading range of 25 to 50 kva per 100 ft on each side of the street which is being served.

For loading higher than about 50 kva per 100 ft, the units would tend to be spaced closer than 400 ft along the street. As this condition is approached, more and more of the load is fed directly from vaults; and fewer services are taken from overhead secondary. At this point the useful range of the semi-underground secondary network is exceeded, and the load density is such that an entirely underground secondary network should be considered.



DISTRIBUTION RECORD MAP SECTION shows circuits, service drops, and the 25-kva distribution transformer serving the residential area

Meter Book Gives Transformer Load

L. J. WEED, Head of Distribution Division, Engineering and Construction Department, Boston Edison Co

Meter book readings today provide loading data for 15,000 overhead single-phase transformers on Boston Edison's distribution system. Clerks collate monthly readings with map records to compute the peak load on each transformer. Resulting data facilitate engineering for connecting new loads or relieving overloads and so save many man hours of field time. First step in setting up the new method was to determine the factors required to translate usage into kilowatts of demand. These factors were attained by comparing actual tests of transformers with meter book readings.

Next step was to determine the mechanics of setting up and maintaining these data, making maximum use of existing records. Upwards of 15,000 overhead and 2,000 underground single-phase transformers, as well as about 2,200 overhead and 750 underground 3-phase transformers are involved. It was decided to check initially the 15,000 overhead transformers by meter book readings and to continue existing load testing on underground and 3-phase overhead units.

Record Maps Are Key . . . Records Division maintains a complete file of 24 x 30-in. secondary sheets showing street lines, buildings, services, poles, wires, transformer locations, cable routes, and other data. These are drawn to scale, each sheet representing a numbered square on a key map, for ready reference. A clerk familiar with meter book readings is furnished with all secondary sheets for the particular area to be studied. On these the clerk enters meter book readings for the various customers supplied by any specific transformer.

Pertinent data are then transferred to a load summary sheet where the total kwhr and total number of customers are entered. Total kwhr consumed by the customers served by this transformer is multiplied by a diversity factor determined by the number of customers. In this case total usage of the 54 "B" and "C" rate customers in the month of January was 5,350 kwhr. Diversity factor of 0.85 reduces this consumption to a calculated 4,550 kwhr.

Extensive testing over a period of years has established a monthly figure of 200 kwhr per kva of transformer peak load. In Table 1 the 4,550 calculated kwhr divided by 200 gives a demand of 22.7 kva, which is 91% of transformer rating. While 200 kwhr per kva does not cover all classes of customers, it has been found representative and simple to apply generally. Special classifications of loads are met in ways described later. It has not been found necessary to have a separate diversity factor for each type of customer.

The company's "B" and "C" rates represent residential or apartment house customers, and its "A" and "H" rates are commercial or industrial. Many of the "A" and "H" customers have demand meters on their services. For others a multiplying factor is used, depending on the type of customer. Again, the kwhr are totaled, divided by 200, and the result is kva demand on the transformer.

Demands of Single Customers . . . For a transformer supplying a single customer the following guide is used:

Kwhr Reading	Kva Demand
0— 200	1
200— 390	4
400— 690	5
700—1200	6
Over 1200	Divide by 200

If 2, 3 or 4 customers are supplied from one transformer, the practice is:

0— 400	Divide by 200
400— 690	5 kva
700— 990	6
1000—1400	7
Over 1400	Divide by 200

Special customers like schools, hospitals, churches, convention halls, etc., require particular attention. A grade school closes in the early afternoon; if its demand is larger than the residential on the same transformer, the school load plus 25% of residential load is taken as the estimated transformer load. If residential exceeds school load, the total residential plus 25% of the school load is taken. But many special customers today require separate transformer installations.

When Relief Is Required . . . After all load data have been totaled on the summary sheet, percent loading on the transformer is calculated. If this percentage is over 120 the sheet is returned to the Engineering and Construction Department for relief. If loading is less than 120% this latest load information is noted on the transformer record card.

February meter book readings are used for routine testing to reflect January usage, which is a typical month on the Boston Edison system. This eliminates abnormal Christmas lighting. In case certain transformers may be heavily burdened in summer months because of air-conditioning, meter book readings for July or August are used. Load studies may thus be made throughout the year without waiting for a particular season to obtain test data.

Keeping Data as Load Is Added . . . Besides obtaining load data on distribution transformers, this method facilitates following the effect of adding load. This is done with the "Distribution Transformer Load Check" (Table II). Estimated demand of new load is added to the estimated transformer load from the IBM card increased by the following percentages to bring it up to date:

5% if checked within 6 months
10% if checked between 6 and 12 months
15% if checked between 12 and 18 months
20% if checked between 18 and 24 months

If latest figure is over 24 months old, a new load check is made.

Electric range load is included using the following demand estimates:

Ranges	Kva range	Ranges	Kva range
1	3.0	8	1.0
2	2.1	10	0.95
3	1.7	15	0.90
4	1.5	20	0.85
5	1.3	25	0.80
6	1.2	100	0.75

If the new total load does not exceed 120% on overhead transformers and voltage drop calculations prove acceptable, it is accepted without transformer change. If the load exceeds 120%, a larger transformer is installed, or secondary mains are split.

This method is also useful for special studies of transformer loading. Peak load data can be computed without waiting for a test during the peak period. And meter book readings on the secondary sheets provide a measure of the load which may be transferred to another transformer or to another circuit when relief is required.

Supplants Costly Testing . . . Study of three years' operation of the former load testing program disclosed that about 5,000 overhead single-phase transformers were tested per year. This required about 5,400 man-hours of labor, about one-third at overtime rates. Two clerks can now compute the load on about 5,000 transformers a year with a total saving of $9,000. This also made available 5,400 man-hours of skilled labor for other types of overhead construction.

Testing practice had already changed from spot testing with clamp-type ammeters to recording ammeter tests. The latter proved successful but placed considerable burden on field forces despite ability to install and remove test equipment during regular working hours. It also required considerable engineering time to supervise the schedule and to translate field data into a form suitable for transformer record cards.

The new method has been in operation about two years. Eventually it will permit checking all overhead single-phase transformers at least every two years. There appears to be no reason why it cannot be extended to certain 3-phase overhead transformers and underground transformers.

Table I—Distribution Transformer Load Summary

Single-Phase Transformer: Kva Size 25 Pole No. 245/5 M.H. No.____
Street Easton City or Town Brighton
(1) Total of all "B" and "C" Rate Kvhrs 5,350

		Kwhr
* Number of "B" and "C" Rate Customers 54	Multiply (1) by .85	= 4,550
(2) Total of all "A" and "H" Rate Kwhrs____	Multiply (2) by .75	= ____
(3) Total Kwhrs for Transformer		= 4,550

Total Kwhrs (3) divided by 200 = 22.7 Kva Demand
Total of all Demands on Tally = ____ Kva
Total Load on Transformer ____ Kva
Per cent of Kva Size 91 %

* *Diversity Factor*

From	0	to	10	"B"	and	"C"	Rate	Customers—	Multiply by	1.00
"	11	"	25	"	"	"	"	"	"	0.95
"	26	"	50	"	"	"	"	"	"	0.90
"	51	"	100	"	"	"	"	"	"	0.85
"	101	"	150	"	"	"	"	"	"	0.80
"	151	"	200	"	"	"	"	"	"	0.75
	Over		200	"	"	"	"	"	"	0.70

Signature_____ Date_____ 19____

Table II—Distribution Transformer Load Check

JOB NAME or TITLE John Smith
ADDRESS_____ ST. CITY or TOWN_____
TRANSFORMER TO BE USED: Kva 15 Ph. 1φ O.H. Yes U.G. No
Location: Pole No. 16/1 M.H. No._____
Street_____ City or Town_____

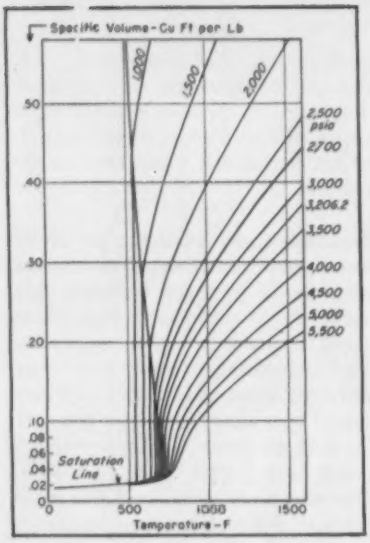
1. Estimated (Sales Dept) Demand of New or Added Load	7 Kva
2. Estimated Up-to-date Transformer Load	21 Kva
3. Estimated Probable Load on Transformer	28 Kva
Probable Per Cent Load on Transformer	186 %

Investigator check action taken:
Transformer Capacity Adequate No
Referred to Distribution Division Yes
Signature_____ Date 1-12-54
Investigator

Engineer check action recommended:
Transformer O.K. No Install Transformer Capacity Yes
Make Secondary Changes Yes

Signature_____ Date_____
Engineer

Supercritical-Pressure



W. H. ROWAND,
Vice-president,
Babcock & Wilcox Co,
New York 17, N. Y.

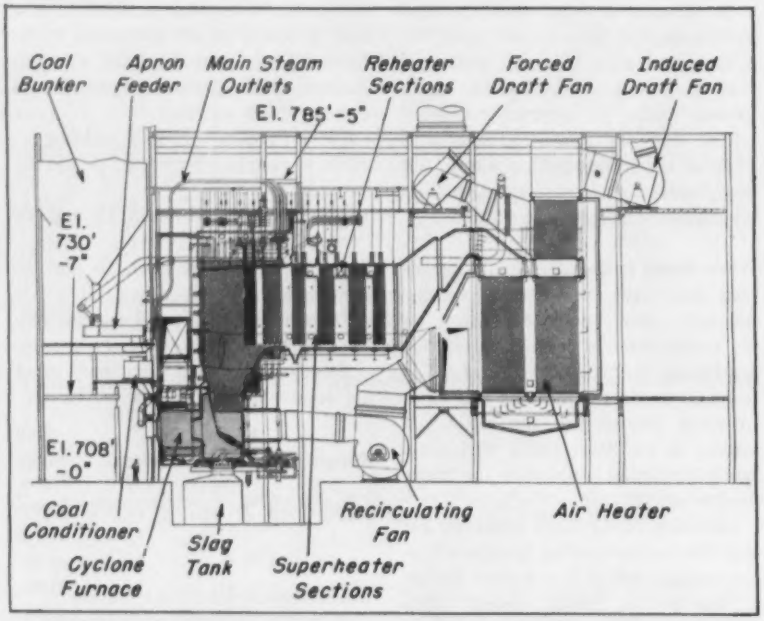


FIG 1—SPECIFIC VOLUME of water (left) is shown as a function of temperature at various pressures (data from "Thermodynamic Properties of Steam," by Keenan and Keyes)

FIG 2—PHILO PLANT side elevation (immediately above) shows the new supercritical-pressure steam generator currently under erection for use on the American Gas & Electric Co system

A.G. & E. System's Philo Plant unit, boosting efficiency through higher steam pressures and tem

A supercritical-pressure steam generator, now being erected at the Ohio Power Co's Philo Station, will furnish three times the kilowatt generating capacity of the unit it replaces at a 40% reduction in fuel requirements per net kwhr. It is expected to be in operation on the American Gas & Electric Co's system early in 1956.

This new generator will use the same building, foundation, and much of the established steel work for the unit it will replace, which was one of the country's first reheat units generating 40 Mw at a heat rate of 14,000 Btu per net kwhr. This generator is a "once-through," "flash" type.

The new unit will be the first steam generator in which the tonnage of alloy steel tubing will exceed the tonnage of carbon steel tubing. Its net heat rate is expected to be about 8,500 Btu per net kwhr, depending on the vacuum in the condenser.

Why Supercritical Pressures? . . . The sponsors of this initial commercial installation at Philo proceeded on the firm assumption that one important way of increasing the efficiency of power generation is through the use of increasingly higher steam pressures and temperatures. Advances in pressure and temperature go hand in hand, and little can be gained by a big jump in pressure without a corresponding jump in temperature.

A design pressure of 2,700 psi is about the limit for either natural-circulation or forced-circulation boilers of the Steamotive or LaMont type. Both depend upon the circulation of an excess amount of water and the separation of this water from the steam in a drum. This separation is possible because of the difference in the densities of water and steam, the difference decreasing progressively as the pressure is increased.

At the critical pressure and temperature, steam and water each weigh about 20 lb per cu ft, and it is no longer possible to effect separation. Consequently, a "once-through" type of steam generator must be used.

The relationship of the change in specific volume of the fluid for various pressures and temperatures is illustrated in Fig 1. A marked change can be seen in the specific volume of steam and water between a pressure of 2,700 psi and the critical pressure of 3,205 psi.

"Flash" boilers, in which the water flows through one or more tubes, receiving heat so that it comes out as superheated steam, have many desirable features. These are elimination of drums, considerable freedom in the shape and routing of tubes, and a very wide range of steam temperature made possible because there is no fixed point of demarcation between evaporating and superheating sections.

Steam Production Triples Capacity,

Cuts Heat Rate 40%

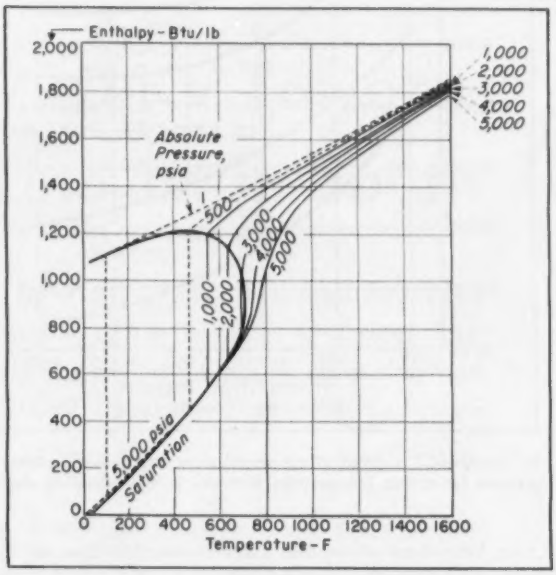


FIG. 3—ENTHALPY of H_2O is a function of temperature at various temperatures (data is from the Keenan and Keye's opus cited)

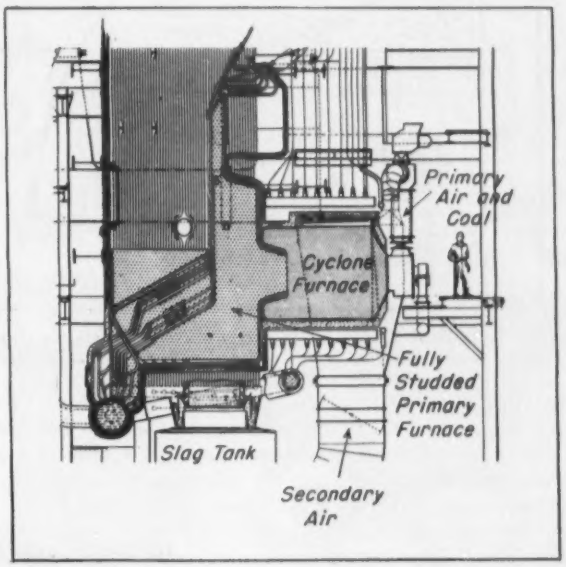


FIG 4—CROSS-SECTION (right) shows a typical Cyclone Furnace and primary furnace with fully-studded refractory covered tubes

peratures, requires only the same space as the 40-Mw reheat generator it will replace

Philo Station Unit . . . In the new steam generator at Philo Station, the feedwater will enter one of three Cyclone Furnaces and flow through each of the three in series and through the primary furnace wall. It will then flow through the primary superheater section, the walls of the mixing chamber, and finally the secondary superheater platens and convection zone (Fig 2).

The two reheat sections will be in series alongside the primary superheater, covering approximately two-thirds of the width. The recirculated gas, taken from the entrance of the air heater, will be re-introduced into the bottom of the mixing chamber just above the slag screen. Products of combustion will pass through the air heater to the stack.

Decision to Build . . . The American Gas & Electric Co, Babcock & Wilcox Co, and the General Electric Co decided in May 1953 to build a commercial coal-fired supercritical-pressure unit to be installed at the Philo plant (EW, June 29, 1953, p 72). Because of the pioneering involved and the many untried features throughout the installation, it was decided to limit its size to as small a unit as possible, while still being commercially practical and making efficient use of the reheat cycle. The size of the unit, it was agreed, would be approximately 125 Mw.

Design pressure of 5,000 psi for the steam generating equipment and steam piping, and the temperature of 1,150 F for the high-pressure steam were determined by the thickness limitations of conventional austenitic steel tubing.

Although a single stage of reheat to 1,150 F was originally contemplated, it was agreed to use a first reheat temperature of 1,050 F and to add a second stage of reheating to 1,000 F to obtain the equivalent heat rate. This decision was made because of the unknowns involved in the first reheat stage of the turbine. The feedwater temperature selected was 525 F.

Special Requirements . . . The difference between supercritical and subcritical conditions is illustrated in Fig 3, which shows the heat content or enthalpy of water for various pressures and temperatures.

On a 2,300-psi unit with 1,050 F steam temperature and 1,050 F reheat with 500 F feedwater temperature, 20% of the heat absorbed is used for the sensible heating of the feedwater to saturation temperature, 32% for the latent heat to evaporate the water, 33% for superheating the steam, and 15% for resuperheating the steam. When an enconomizer has not been installed and all sensible heating and evaporation of water takes place in the

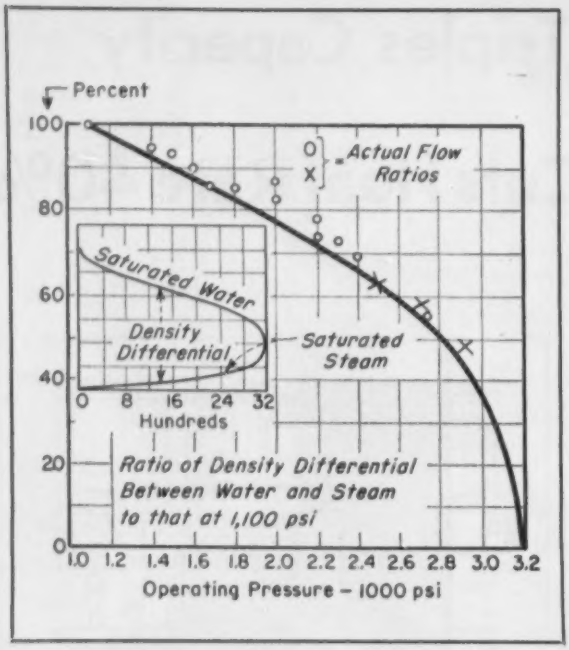


FIG 5—ACTUAL CIRCULATING FLOW is compared with the theoretical density differential (Twin Branch and Alliance Research data)

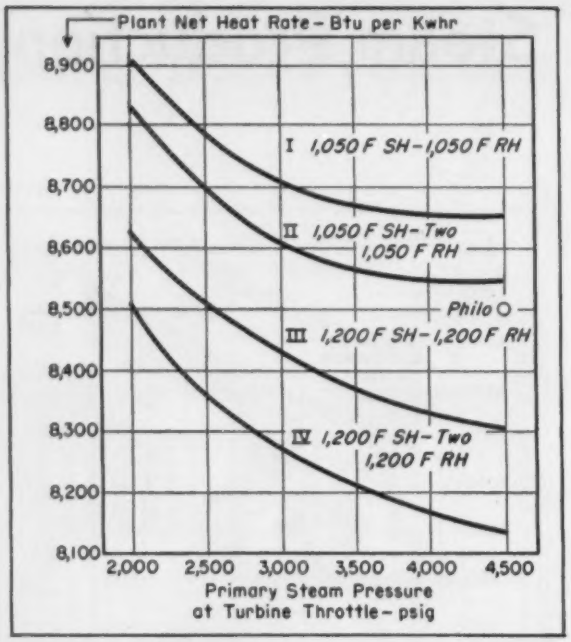


FIG 6—EFFECT is shown on net overall plant heat rate of increasing pressure for various temperatures with one or two reheating stages

furnace walls, the products of combustion give up heat from the adiabatic temperature down to a furnace exit gas temperature of 2,200 F. The superheater and reheater further cool these gases from 2,200 to 800 F.

In a cycle for 4,500 psi and 1,150 F steam temperature with two stages of reheat, one to 1,050 F and one to 1,000 F with 525 F feedwater temperature, 19% of the heat absorbed is used for the sensible heating of the feedwater to the critical temperature of 705 F. There is no longer any latent heat for evaporation. Then 60% of the heat absorption goes for superheating the steam and 21% for the two stages of reheating.

Obtaining constant high steam temperatures over a wide range of load is no problem, since there is no fixed point of surface where superheating begins. It is only necessary to control the firing rate in relation to the feedwater flow rate to obtain the desired temperature.

Keeping the tubes lining and cooling the combustion chamber at low enough temperature and stress level over the range of load becomes the paramount problem. These must "live" satisfactorily and give reliable trouble-free operation. Fluid in the tubes must be as low in temperature as possible, and the film transfer rate between fluid and tubes as high as possible.

Universal Pressure Design . . . The Cyclone Furnace insures complete combustion of fuel, whether coal, oil, or gas in about 1/20 of the furnace volume required for the complete combustion of pulverized coal. Because of the small amount of cooling required to line this small combustion space, the gas temperature leaving the furnace is higher than 3,200 F.

Full stud covering on the primary furnace surfaces and recirculation of a relatively large quantity of cooled combustion products to cool rapidly the combustion gases immediately after passage through the slag discharge zone keep heat absorption rates reasonably low on the surface for superheating and reheating. Fig 4 is a cross-section through a Cyclone Furnace and primary furnace illustrating these zones.

A most important key to the successful operation of the Philo equipment is water conditioning. Present indications are that it will be possible to obtain satisfactory water conditions through the use of practical equipment and operating practices, although a high degree of supervision will be necessary during operation.

Factors in the unit's development were: Heat distribution; close tube thickness tolerances; sensitivity of response to changes in operating conditions; suitable support to take care of variations in tube temperatures; the many requirements of starting up and shutting down, including shock on hot headers and steam piping and the selection of satisfactory materials; and welding and other fabrication techniques.

Higher Operating Pressures . . . The 2,650-psi unit for the Twin Branch Plant of Indiana & Michigan Electric Co on the American Gas & Electric system went into operation in 1941 (EW, Oct. 18, 1941, p. 81). It is a pulverized-coal-fired unit for 75 Mw, delivering 550,000 lb of steam per hr to the turbine throttle at 2,300 psi and 940 F, with one stage of reheating to 910 F. This boiler was the forerunner of the great many high-pressure reheat units operating on the single-boiler-per-turbine principle built since World War II.

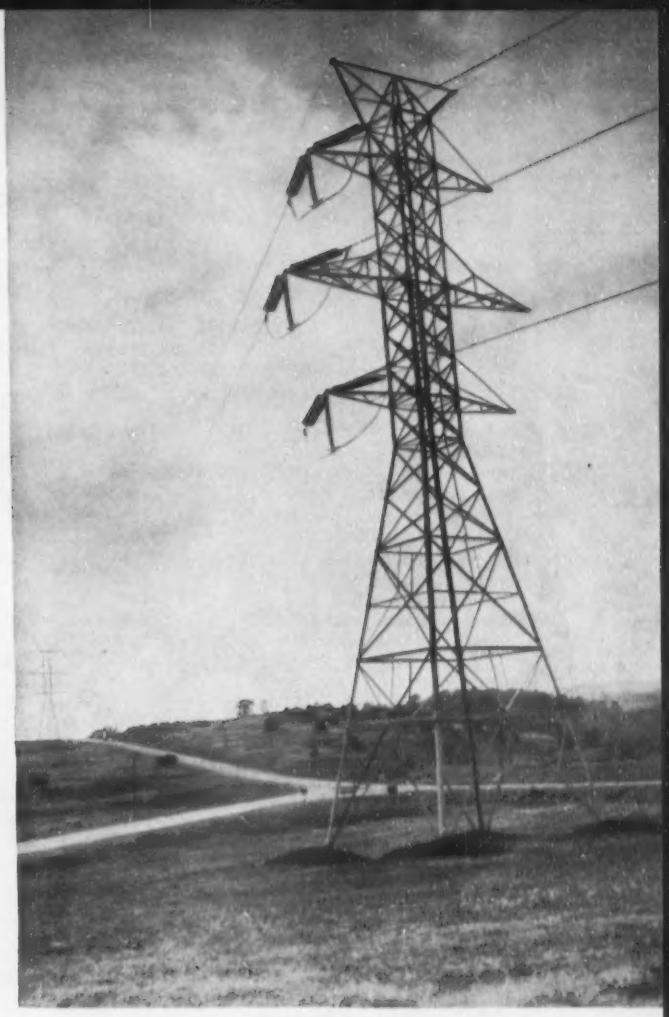
Experience was sufficient with outside downcomers and Cyclone Separators to go ahead at that time with natural circulation for an operating pressure of 2,500 psi. Actually, the original circulation was reduced 10% by the installation of 16½-in. diameter orifices in the two 28-in. diameter downcomer pipes. This permitted operation

(*Continued on page* 172)

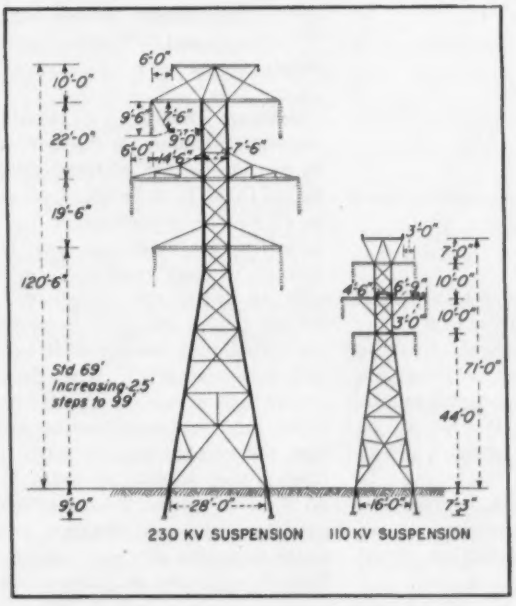
230-Kv Tower Line 1st in South

Duke Power links Riverbend and Tiger Stations across 75 miles with steel-tower line costing $6 million. Line is first part of EHV "backbone" over 100-kv system

M. R. KIMBRELL, Electrical Engineer, Duke Power Co, Charlotte, N. C.



Steel tower initially carries single 230-kv circuit. Drawing shows details of steel tower



The South's first steel-tower, 230-kv line, completed recently by the Duke Power Co, traverses 75 miles of rolling country between Riverbend Station near Charlotte, N. C., and Tiger Station at Duncan, S. C. This line with its terminal facilities at Tiger, its western end, cost $6-million and is an important part of Duke Power's $250-million postwar program for serving the greatly increased power needs of the Piedmont area of the Carolinas.

This new 230-kv line is the initial section of an extra high voltage "backbone" overlaying the older 100-kv system extending from Tiger to Riverbend and from Riverbend to Eno Station near Durham, N. C., eastern end of the present system.

With the insulation used and its low tower footing resistance, tripouts on the 230-kv line are not expected to exceed one every two years although the area averages 55 storm days per year. Conductor protection and fast acting oil circuit breakers with carrier-current relaying assure a near trouble-proof line.

Riverbend Generation . . . When Duke Power purchased a 150-ft right-of-way between Riverbend and Spartanburg in 1926, costs favored adding steam stations in the system's

Riverbend-Tiger 230-Kv Line Statistics

General				
Voltage nominal	230 kv			
Length—miles	74.96 (19.1-2C + 55.9-1C.)			
Rating per circuit—Mva	150			
No. of circuits	2 (1 now + 1 Future)			
Structure	Steel			
Towers	No.	Wt.		
Suspension	400	19,272		
Light angle	28	36,210		
Heavy angle or dead end	13	44,581		
Configuration of tower shown by sketch.				
Conductors	795,000 CM ACSR-26/7			
Weight per ft	1.098			
Diam. inches	1.108			
Span average—ft	900			
Tension max load, ½-in. Ice, 8-lb wind @ 0F	10,000			
Sag final @ 60F—ft	25			
@ 120F	28			
Tension at 60F—lb	4400			
Min clearance to ground @ 120F	35			
		Kv—Flashover		
Insulation		60 Cycle		1-½ x 40
		Dry	Wet	Critical Negative
Units 5¾ x 10 in. discs 15,000 lb				
Suspension 1 string	18	965	705	1615
Strain Yokes 2 strings	20	1055	775	1785
Cl Cond to tower 30 swing, 9 ft-0 in. corresponding ½-in. square rod gap				1750
Ground Wires				
Number	2			
Mat'l & size	⅜ in. H.S. St.			
Angle of protection at tower—deg	17			
Mid. Span—deg	11			
Average—deg	12			
G.W. to conductor at mid 900-ft span at 60F	31 ft 2 in.			
Ground res ohms	Final readings not in.			
Ground Rods—at each footing—10 ft lengths ⅝ in. 1 to 3 as far as can be driven				
Counterpoise, if needed, to bring tower footing ave. resistance to	20 ohms.			
Arcing Horn at clamp	Yes			
at top of string	No			
Dampers—Believe unnecessary, but is being checked for vibration.				
Armor Rods	preformed			
Relaying	Carrier, distance			
Breaker interruption cps	3			
Reclosing time "	20			
Interrupting Capacity	5 Million			

end zones. The utility decided in 1951 to add two 150,000-kw steam electric units at Riverbend and to build the 230-kv steel-tower line from Riverbend to the Tiger steam station at Duncan, S. C.

The two new units at Riverbend will generate at 18 kv, each unit being connected directly to a 150,000-kva, 18/230-Y-kv, 3-phase transformer. On the high-tension side, a 230-kv, 3-cycle opening oil circuit breaker of 5-million-kva interrupting capacity connects the transformers to a 230-kv bus which is the present circuit to Tiger. A 75,000-kva, 18/100-kv, 3-phase transformer is connected to each generator 18-kv bus through an oil circuit breaker to the station's 100-kv bus.

These two units boost the total continuous generating capability of the Riverbend Plant to 665,000 kw, largest in the Duke Power system.

Tiger Installations . . . At Tiger, the other extremity of the 230-kv line, are two 150,000-kva, 3-phase, 230Y/100Y-kv autotransformers, each with a tertiary of 40,000 kva at 44,000 v. The primary sides of the transformers are connected to the 230-kv bus by gang disconnecting switches operated electrically.

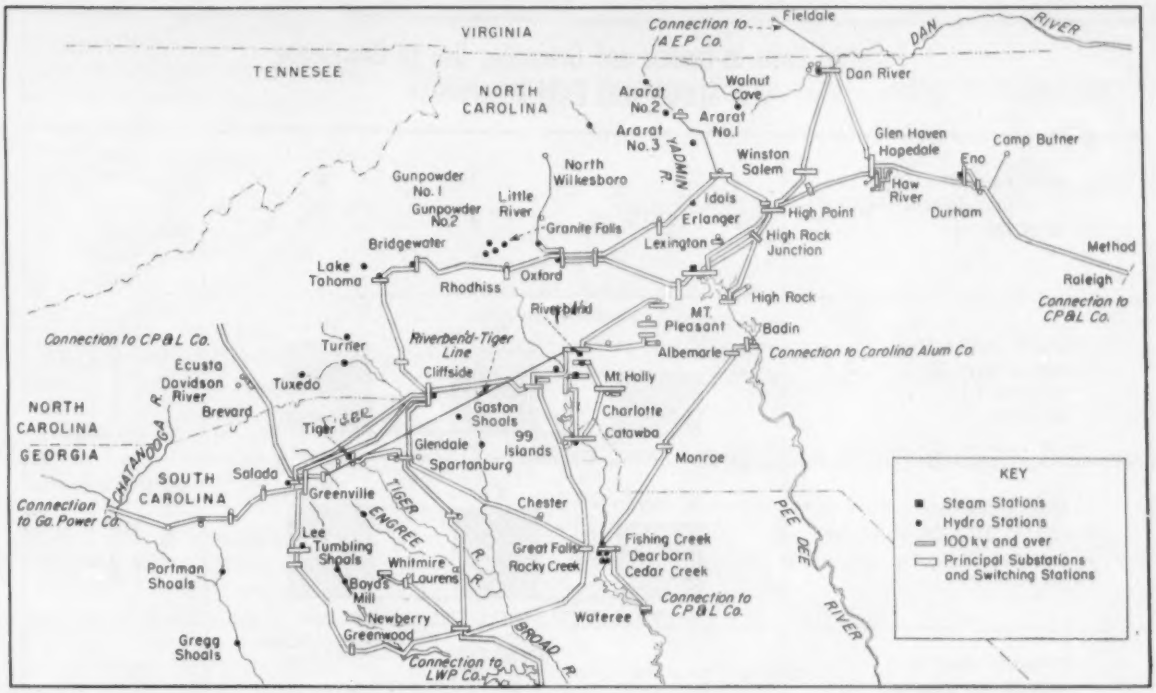
Each transformer's 100 and 44-kv windings are connected through oil circuit breakers to the station's 100 and 44-kv buses feeding lines radiating therefrom. There are ten 100-kv and two 44-kv outgoing circuits. At present, the 230-kv circuit is connected directly to the main bus.

Installation of a second 230-kv circuit will necessitate oil circuit breakers on the two outgoing circuits at the Riverbend Station and on the two incoming circuits at Tiger Station and on the primary side of each transformer.

Need for Second Circuit . . . The single 230-kv circuit, judging by present load trends, will have to be supplemented by a second circuit before the end of 1957. Accordingly, an evaluation of costs indicated that it would be more economical to build a double-circuit steel tower line with one circuit installed and provisions for a second circuit when needed. Estimated total costs per mile were $40,000 for a single-circuit steel tower line and $60,000 for the double-circuit tower line using 795-MCM ACSR.

Conductors of 795-MCM ACSR with stranding of 26/7 instead of 30/19 were chosen because they are 8% cheaper and 11% lighter although amply strong.

Conductor Loading . . . Maximum mechanical loading for this cable area, as set up by the National Electric Safety Code, is ¼-in. ice, 4 psi wind, at 15 F, with a constant of 0.22 psi added to the resultant. But Duke Power's 50 years' experience, together with the importance of the new 230-kv line, guided the utility in establishing a maximum loading of ½-in. ice, with 8-psi wind at 0 F. When the conductor has a tension of 10,000 lb under this maximum loading condition, the average span of 900 ft will have a final tension of 4,400 lb at 60 F. This tension is low enough to eliminate conductor vibration except under extremely abnormal conditions. With 1¼-in. radial thickness of ice at



TRANSMISSION SYSTEM of Duke Power Co, Charlotte, N. C., supplies the Piedmont area of North and South Carolina. Map shows new line joining Riverbend Station with Tiger Station and the other 100-kv and the larger lines in the utility's currently expanding power network

32 F and no wind, there will be tension of 16,200 lb, which is 5,760 lb less than the elastic limit of the conductor.

The 230-kv line, although often exposed to severe lightning, must deliver power continuously into the Greenville area with a minimum of interruptions. Type of soils traversed are approximately 70% sand, clay, and loam; 10% sand-clay with small particles of mica; and 20% sand and clay with rock 2 to 15 ft below the surface. The lightning level and the indicated high ground resistance dictated the need of heavy line insulation.

Insulation . . . A study of insulation on 39 existing 230-kv lines showed that the number of 5¾ by 10-in.,' or equivalent, insulators ranged between 11 and 18, the exception being the Hoover Dam-Los Angeles lines which use 21. Data from this study are:

Isokeraunic Level	5	15	25	35	45
Number of Lines	17	5	7	9	1
Units Used—Max/Min (5¾ x 10-in. or equivalent)	11/17	12/16	15/16	14/18	18
Average Units	14	15	15.7	17	18

These data indicated that the use of 18 units would be required. Using the AIEE method of estimating lightning performance of transmission lines (AIEE Paper 50-163), calculations showed that with 18 insulators and a 20-ohm tower footing resistance, the line will have one-half outage per year.

Insulators are the ball and socket type, 10 by 5¾-in. spacing, 15,000-lb units. For suspensions there are single strings of 18 units, and strains are of double strings of 20 units each.

Armor Rods and Arcing Horns . . . At each suspension, pre-formed armor rods protect the wire from flashover burns and minimize the effects of any vibration. A big arcing horn has been installed on the conductor clamp.

Strain clamps are of the through type which eliminates cutting the conductor when compression fittings are being installed at strain points.

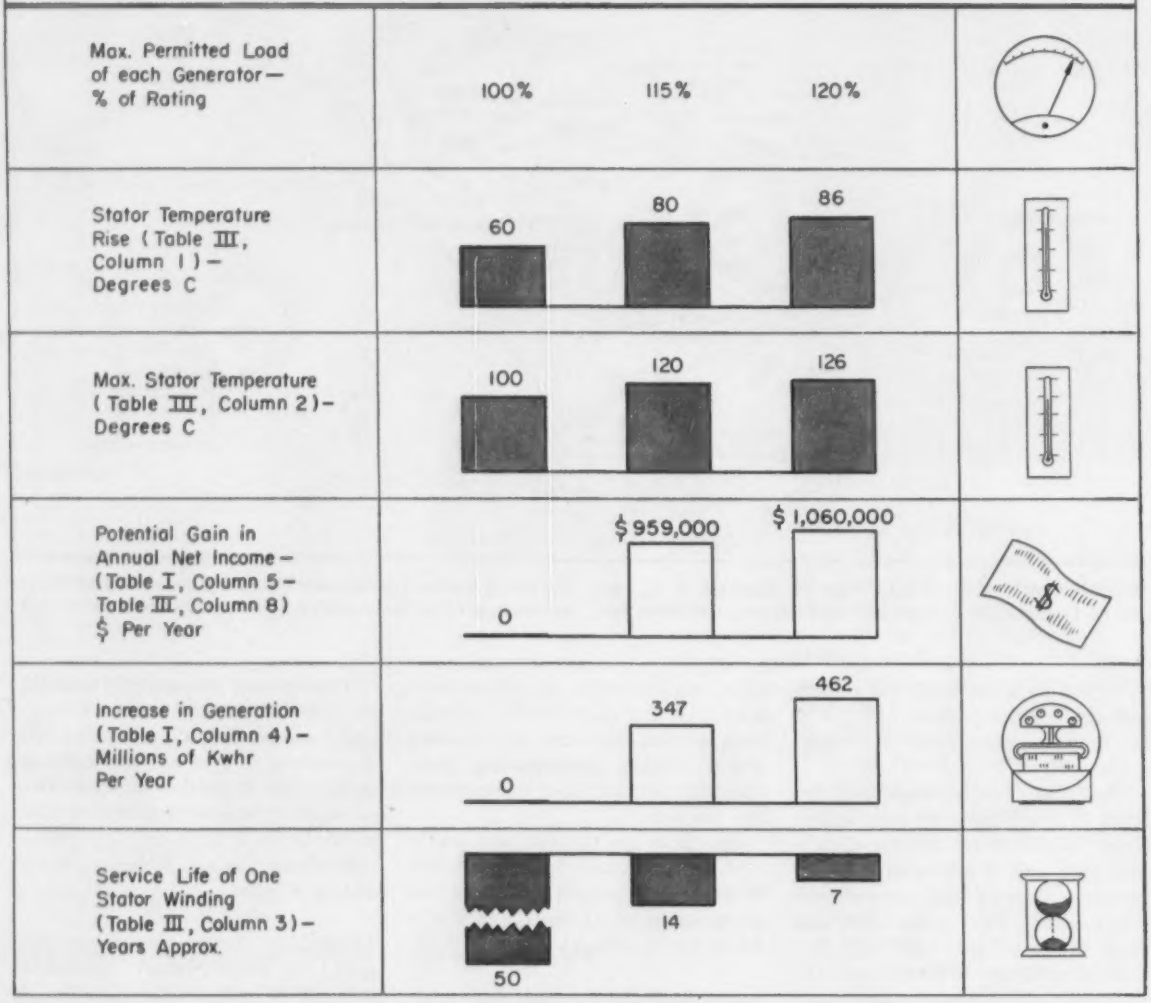
Corona tests on the suspension assembly with the arcing horn showed a radio interference voltage of 125 μv for 140 kv to ground (240 kv between phases). But with the big arcing horn this radio interference voltage was reduced to 55. The strain double-strings yoked without corona prevention had a radio interference voltage of 300 μv for the 140-kv to ground. These tests indicated the line wouldn't affect radios.

Two ground wires of ⅜-in., HS galvanized steel were used. Tension under maximum loading will be 3,800 lb, resulting in a 14-ft sag in a 900-ft span, 1,970 lb tension at 60 F with no wind. Mid-span clearance to conductor at 60 F is 31 ft 2 in., practically eliminating any flashovers at the middle of spans.

Towers . . . Tower outline was suggested by Duke Power's experience with 100-kv lines. Horizontal offset of middle-arm conductor, vertical distance between crossarms, and horizontal offset of ground wires are double those on the older 100-kv towers. When the conductor is 30 deg from the vertical, the clearance from the body of the tower is 9 ft and from its supporting crossarms 7 ft 6 in.

The average span is approximately 80% of the length of the design span. The design span is 1,100 ft for the suspension towers under maximum loading conditions with one wire broken with a tension of 10,000 lb. Strain towers are designed for a span of 1,500 ft with any three wires broken and at an angle of 15 deg for light strains. The same spans apply to heavier strains under the same conditions, except for angles up to 45 deg, and to deadends.

Potential Gains in Income and Generation Due to Overloading
(For Station with Eight Generators)



It Could Pay to Overload Generators

Technically feasible higher loads and temperatures involve the acceptance of more frequent replacements of stator windings with a consequent increase in annual costs. Income and kwhr gains favor a change in loading philosophies

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Operating generators at higher loads and temperatures may yield substantial gains in dollars and kilowatthours. And it could be sound business policy to accept the greater frequency of stator winding replacements incident to such increases. The economics, of such a proposal involves weighing the gain in net operating income from power sales against the increased expenses arising from winding replacements and outages.

The general approach of measuring the expected increase in annual net income from higher loading against the ensuing increase in annual operating expenses is always of value, even though each case must be considered on its own merits. A net income increase from existing plant investment will ultimately tend toward higher utility income and lower rates for consumers.

Possible gains of millions of kilowatt hours and dollars make it worthwhile to review the loading philosophies of specific generating stations. Such studies, requiring skillful consideration of all pertinent technical and economic factors, may pay off for some utilities.

Some Technical Considerations . . . Although ASA Standard C50-1943 allows 80 C temperature rise above 40 C ambient for Class B insulated stator windings, many utilities today operate at only 60 C temperature rise or less. There are no technical reasons, however, why generators cannot be operated at higher loads and at temperature rises greater than 80 C above 40 C ambient.

Presumably, generators are operated at lower temperatures to prolong stator winding life with a view to maximizing reliability. But it is doubtful whether long life is an essential element in maximum reliability which can be maintained, despite increased loading, by more frequently scheduled winding replacements. Such winding replacements could be further supported by regular checks on insulation condition by the improved non-destructive tests now available.

This procedure is practicable in the light of AIEE Standard No. 1—June 1947, which points out:

"Insulation does not fail by immediate breakdown upon arrival at some critical temperature but by gradual mechanical deterioration with time. Therefore, the question of how hot an insulation can be operated can be answered only on the basis of how long it is desired to have it last . . . The question of what should be considered a desirable life for insulation is largely one of economics."

Gain in Operating Income . . . In evaluating the economics of higher loads and temperatures, a hypothetical hydroelectric station is considered. This station comprises eight similar waterwheel generators, each rated 60

Table I—Increase in Income Due to Higher Loading for 8 Unit Station

	Max Permitted Load of Generator % of Rating		
	100%	115%	120%
1 Nominal station capacity—Mva....	480	480	480
2 Nominal station capacity—Mw....	432	432	432
3 Kwhr Generated—millions/annum.	2311	2658	2773
4 Increase in kwhr generated above rated conditions—millions/annum	0	347	462
5 Increase in Net Income—$/annum..	0	1,145,000	1,525,000

Table II—Expenses During Life of Stator Winding of 60-Mva Unit

1 Estimated cost of new stator winding.....	$165,000
2 Estimated labor and overhead of installing same....	72,000
3 Cost of 3 minor winding failures prior to rewind at $1,000 each	3,000
4 Outage time during winding repairs and replacements:	
a 7 weeks time (max for one rewind)	
b Plus 32 hours for each of the 3 minor winding failures	
Total	53 days
5 Generation lost during outage time—kwhr.....	42,000,000
6 Extra cost of replacement steam power during outage time	203,000
7 Total expenses during service life of one stator winding	$485,000

Table III—Increased Expenses Due to Higher Loading for 8 Unit Station

	Max Permitted Load of Generator % of Rating		
	100%	115%	120%
1 Temp rise of stator—deg C.....	60	80	86
2 Max stator temp with 40°C cooling air—deg C.....	100	120	126
3 Estimated min life of one stator winding prior to rewind—Years	50	14	7
4 Average generator years of service between winding failures—Years	18	4.6	2.6
5 No. of minor failures prior to rewind—Approx	3	3	3
6 Expenses during life of one stator winding (from Table II—column 7)—$	485,000	485,000	485,000
7 Annual prorated expenses for eight generators—$/annum ..	25,400	212,000	490,000
8 Increase in annual expenses due to overloading eight generators—$/annum	0	186,600	464,600

Mva, 90% pf, 13.8 kv, 60 cps, for a 60 C rise above 40 C ambient, and capable of 15% overload with an 80 C rise. Stator heating is assumed to be the limiting feature because the rotor, turbine, exciter, transformer, etc, have excess capacity and ample water is available. Average North American economic and operating conditions are also assumed to apply to this station.

The potential increase in net income from this station's power sales as a consequence of higher loading is given in Table I. It is assumed that annual net income varies linearly with annual kwhr output. Actually this presents a pessimistic estimate of the increase in income because some elements of operating expense, including interest and fixed charges, do not change with output. The potential increase in net income is partially offset by the slight decrease in transmission and distribution efficiency resulting from higher loading.

The computations in Table I are simplified when it is assumed that the generators operate at maximum permitted load part of the time and are shut down completely at other times. In 1951 Canadian hydroelectric plants averaged 5,349 kwhr generated per annum per kw installed. In 1952, U. S. plants averaged 5,350 kwhr per annum per kw installed hydroelectric. Table I is based on the latter more conservative figures.

Canadian stations' revenue during 1951 was $293 million, while total expenses (wages, salaries, fuel, taxes, and cost of power only) were $155 million, or 52.7% of revenues. The average revenue per kwhr consumed was 6.8 mills, and hence the average increase per additional kwhr sold is about 3.6 mills.

In the U. S., private utilities had an average operating income (excluding income deductions, such as interest on debt) amounting to 19.5% of electric operating revenues during 1952. Total electric revenues were $5,660 millions, while total kwhr sold were 332 billions. Average revenue per kwhr sold is thus 17 mills, so that the average income per additional kwhr sold is about 3.3 mills. Table I is based on the United States figures in order to be on the conservative side.

Increased Operating Expenses . . . In determining the increased annual operating expenses for more frequent winding replacements as a consequence of higher loading, the primary step is an estimate of the expenses incurred during the service life of a single stator winding. The service life between rewinds is then considered. Finally, the expenses are prorated on an annual basis.

Expenses incurred during the service life of one stator winding are detailed in Table II. These include:

1. The cost of replacing one winding.

2. The cost of three minor coil failures prior to rewinding.

3. The extra cost of replacement steam power during outages.

The generation lost during outage time is calculated from the average load factor corresponding to 5,350 kwhr generated per annum per kw installed, values which appear in Table I.

In the United States, where steam plants predominate, average production expenses were 4.84 mills per kwhr during 1952. In eastern Canada, an incremental cost of 4 mills per kwhr of steam power has been estimated. Table II is based on 4.84 mills per kwhr to be on the conservative side in calculating expenses during the life of one stator winding for one 60-Mva generator.

Service Life of Winding . . . The service life of a stator winding is determined by the operating temperature which, in turn, is a function of the load on the generator. When the manufacturer has not built any margin into the generator, its temperature rise at rated load is 60 C. Heat runs on actual generators have shown the assumption that stator temperature varies as the square of the Mva conservatively overestimates the actual temperature rise. Stator temperature rise of the generator at various loads, calculated on this basis, is shown in Table III, line 1.

With the usual closed circuit ventilation and cooling water temperature normally encountered in North America, the cooling air temperature usually is below 40 C. Maximum stator temperatures under these conditions are shown in Table III, line 2. The service life of a stator winding at the various temperatures and corresponding loads can then be estimated as has been indicated in Table III, line 3.

A statistical report by the Canadian Electrical Association states that rewinds occurred in ten to fifteen years on the great majority of waterwheel generators in the 121-130 C range. The life of Class B insulation at 126 C, according to laboratory test values, varies between seven to 20 years. The figures in Table III are thus conservative because they allow for more frequent rewinding than is considered essential.

In prorating expenses for increased frequency of winding replacements, costs can be treated in the manner of an annual depreciation charge. For the hypothetical hydro station with eight units, such depreciation is calculated by the sinking fund annuity method at 4% interest. The increase in annual operating expenses, so determined, is shown in Table III, line 8.

Income and Generation Gains . . . The potential gain in annual net income is obtained by substracting the increase in annual expenses in Table III, line 8, from the corresponding increase in annual income in Table I, line 5. The increase in kwhr generation per annum, determined in Table I, line 4, is included for comparison.

The gains in annual net income at various load levels, shows that it pays to load the eight units well above the specified 60 C temperature rise and also above the ASA rise of 80 C for Class B insulated generators. By operating at 20% overload, 86 C temperature rise and 126 C maximum stator temperature, it is possible to increase generation by nearly half a billion kwhr per annum, with a potential gain in net income from existing investment of more than a million dollars per annum.

It must be realized, however, that the estimates applying to this hypothetical hydro station are indicative merely of a trend. The analysis is based on averaged North American figures, and any individual machine may differ appreciably.

Various technical and economic limitations frequently preclude high overloads in many generators. Sometimes it may be desirable to increase the Mvar loading without change in the Mw load. An appropriate annual dollar value can be assigned to such reactive power.

This article expresses the author's personal ideas and must not be construed as necessarily reflecting the views of his company.

LOOKING OVER THE STATISTICS OF COOLING TOWERS

Survey of $20,000,000 worth of towers for some 4,000,000 kw of recent plant capability also shows 865 gpm per kw and a half acre of ground area per 100 Mw of generating capacity

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Cooling towers for steam plant condensing water have taken on a sharp increase in the last five years. The reason is simple—generating capacity requirements has been outstripping the flow capabilities of streams near areas where electric utility system load has been growing.

In 1953 alone member companies of the Cooling Tower Institute sold 38 installations to private and public steam generating plants. These represented a utility system outlay of over $6,700,000 with over $4,000,000 representing the tower's exclusive of concrete bases, fans, pumps, piping etc. Likewise they represent a combined capacity of just over 1,000,-

Statistics of Cooling Tower Installations

NUMBER	1	2	3	4	5	6	7
GEOGRAPHICAL AREA	WNC	WNC	WNC	WNC	WNC	WNC	WNC
UTILITY	Kan G&E	Iowa EL&P	Iowa P&L	Peoples G&E	Omaha PPD	Interstate Pwr	Northwestern PS
STATION	M. Gill No. 2	Sutherland	Des Moines No. 2	Mason City	So Omaha	Albert Lea	Mitchell
Init Mw/units	124/2	66/2	60/1	20.5/4	15/1	9/1	7.5/1
Ult Mw/units	-/4	132/4	.....	20.5/4	15/1	.....	.....
Init operation	2/52	12/54	3/54	.....	6/48	-/42	-/48
Steam pressure, psi	1250	650	1250	425	450	400	600
Superheat/Reheat, F	950/-	900/-	950/-	700-900/-	780/-	825/-	825/-
Stream name	Deep Wells	Wells	Des Moines	Willow Cr	.....	Albert Lea Lake	.....
Normal flow, cfs	.....	.....	Adeq.	20	.....	.....	.....
Minimum flow, cfs	.....	.....	87	Negl.	.....	.....	.....
Pk Season str temp, F	.....	.....	84	74	90	85	.....
Ruling wet bulb, F	.....	74	75	73	67	.....	.....
TOWER DESIGN							
Spec'd water from cond, F	106.74	100.8	102	104	100	95	100
Spec'd water from tower, F	90.3	85	90	90	85	82	85
Spec'd water rate, gpm	52,300	49,200	65,000	10,000	20,000	9,800	10,000
Temp reduction by tower, F	16.44	15.8	12	14	15	13	15
Spec'd wet bulb, F	76	74	75	73	72	70	73
Approach temp, F	14.3	11	15	31	.....	.....	.....
Corresp'd'g cond vac, in. Hg	1.8	2.5/1.5	2.48	2.7	1.9	1.5	1.9
Recirc into stream?	No	No (closed)	No	Tow to Intake	No	No	No
TOWER DIMENSIONS							
Init operating date	2/54	12/54	3/54	8/40	6/48	-/42	-/48
Length, ft/in	109	241	97	61	97	109	63
Width, ft/in	63	66	62/8	54	63	27	61
Height, ft/in	34/3	32	37/9	20	28	30	26/9
Evap surf, (W)ood (P)ipe	.....	W	W	W	W	.....	W
Draft, (F)orced (I)nduced	I	I	I	I	I	I	I
Fan, total Hp/No	350/7	460/10	375/5	90/3	216/4	121.2/6	120/2
Pump, total Hp/No	1200/2	1000/4	1800/2	100/2	200/2	200/1	200/2
Est'd hr oper per yr	8,760	8,760	504	6,000	8,320	8,760	8,760
COSTS (dollars)	.....	Note (1)	Note (2)	Note (3)	Note (4)	.....	.....
Concrete basin	35,000	30,000	.....	5,000	20,800	.....	14,000
Fans pumps wir'g, pip'g etc	Incl. in tow	Incl. in tow	.....	10,700	25,042	.....	6,400
Tower only	196,600	162,000	.....	15,000	43,438	.....	35,000
Total for installation	231,000	192,000	406,000	30,700	89,280	.....	55,000
Dollars/kw unit net cap	3.85	2.91	7.67	1.60	5.95	.....	7.35

Notes:

1. Does not include water tunnels or piping outside tower propur; well water for makeup.

2. Unit operates about 21 days per year; prior unconventional cooling tower and circulated river water at other times. Costs not definitely segregated. Costs attributable to new cooling tower installation are estimated.

000 gallons per minute of water circulated through the towers. Average reported cost of 1953 tower orders is indicated as about $108,000.

The ELECTRICAL WORLD survey reported here covers towers installed since the wave of new commitments started about 1948. The accompanying table embraces nearly 4,000,000 kw of plant capacity for which practically $20,500,000 was spent in providing water cooling towers.

Costs . . . Dollars per kilowatt cost of water cooling towers depends on the interplay of all factors associated with water temperatures, air humidity, size of plant, terrain, hydraulic heads, etc. The index would be expected to vary quite widely and this spread is encountered in analyzing the reported data. Overall average for some 3,300 Mw of capacity is almost exactly $6 per kw. Segregating the 2,396 Mw of plants relying on well, lake, and city water sources from the 892 Mw of stream flow plants, the well water plants average about $6.20 per kw and the stream-flow plants about $5.85. The $6.20 figure may not be altogether precise, however, because it is not in some instances certain exactly how much of the cost of the wells and circulating water piping has been included in reporting.

Overall spread in the costs per kw is from $1.60 to $20.40. For the well-city-lake water group of plants the spread is from $2.73 to $12.50. For the stream-flow plants it is from $1.60 to $20.40 per kw.

In 52 Power Plants in the United States

8	9	10	11	12	13	14	15
WNC	WNC	WSC	WSC	WSC	WSC	WSC	WSC
Otter Tail	Otter Tail	Texas P&L	Texas ES	Gulf States	PS Okla	Dallas P&L	Okla G&E
Devil's Lake	Jamestown	Collin	No Main	Louisiana No 9	Southwestern	Parkdale	Mustang No 3
12.5/2	8.5/2	145/1	75/1	66/1	160/2	87/1	110/1
2	2	.....	–/1	–/1	–/4	.....	–/1
10/48	12/48	3/55	2/52	5/53	6/52	6/53	–/56
400	600	1450	1250	675	900	1250	1450
780/–	825/–	1000/1000	950/–	900/–	900/–	950/–	1000/1000
Lake MU	Well MU	Deep Wells	Trinity R	Deep Wells	Washita	Well	Lake, wells
.....	.....	.....	Not	Not	.....	1000 gpm	.....
.....	.....	.....	ap-	ap-	6.6	.....	.....
.....	.....	.....	pli-	pli-	.....	118	.....
68	71	.....	able	able	78	79	78
90	94	110	100	111.2	103.5	100	103.5
80	80	91	90	92	86.5	90	86.5
18,400	10,640	85,000	57,000	48,000	60,000	57,000	60,000
10	14	10	10	10.2	17	10	17
65	70	78	76	80	76	76	75
15	10	13	14	12	11.5	14	11.5
2.5	2.5	2.5 approx	Not spec.	2.5	2.15	2.5	2.25
No	.....	.....	No	.....	No	.....	No
9/48	12/48	3/55	3/52	5/53	En of 2 7/52, 3/54	5/53	–/56
96	73	211	193	241	198	191	241
41	61.8	86	63	61	63	64	63
18	25	40	38	49/0	38/1	46 (Note 3)	38/1
W	W	Rod W	W	W(13,824)	Rod W	W	W
I	I	I	I	I	I	I	I
120/8	180/6	700/14	480/8	640/16	496/8	720/12	750/10
300/3	180/3	2500/2	1600/2	1200/2	1600/2	1600/2	1800/2
8,760	8,760	8,000	8,760	8,300	8,000	8,000	8,200
.....	.....	Note (5)	Note (6)	Note (7)	En of 2	Note (9)	.....
30,000	25,000	85,000	58,620	227,900	85,000	90,000	.....
incl in tow	incl in tow	310,000	15,800	.....	329,500	310,000	.....
72,000	57,500	229,000	148,985	375,516	203,000	200,000	.....
102,000	82,500	594,000	223,451	634,677	503,500	700,000	.....
8.16	9.70	4.1	2.86	9.46	7.34	8.05	.....

3. Located over dammed creek. Deep well make-up. Combination of cooling tower, stream flow, pond dissipation and 56 F well water is used at this plant. There is low duty imposed on tower. Low duty on tower.

4. No. 1 turbine is 30 psi exh. non-cond.-unit with extraction at 175 psig; No. 2 is a dble, auto extraction cond. unit with extraction at 175 psig and 30 psig supplying process steam to 3 major meat packers.

The Cooling Tower Institute expresses the unit cost of towers (1953) in terms of the gallon per minute rating of the installations and the average is $3.70. Since the ELECTRICAL WORLD survey shows an average of 835 gpm per kw this means—for cooling towers alone—that the unit cost is approximately $4.45 per kw of generating station capacity.

Areas and Volumes . . . The square feet and cubic feet of water cooling tower space varies even more in range than the unit cost. This is evidenced by a spread from 0.017 to 0.635 sq ft per kw, with an average of 0.220 sq ft per kw. Volumes of the towers range from 0.81 to 17 cu ft per kw with an average of 6.90. On the basis of the area average it is seen that a 100 Mw plant could well require as much as 22,000 sq ft of ground space or practically half an acre for its associated cooling tower installation.

Water Volume . . . Amount of water circulated per kw of plant capability naturally differs somewhat with the temperature of the available water, the wet bulb temperature of the surrounding air as well as with the size of the tower and the desired vacuum. The spread in unit (per kw) values is very great, i.e. from 219 to 2300 gpm per kw for well-city-lake water sources and 420 to 1,250 for stream sources. The general average is 835 gpm. For well-city-lake water sources it is 830 gpm per kw and for stream-flow plants 865 gpm per kw.

Statistics of Cooling Tower Installations

NUMBER	16	17	18	19	20	21	22	23
GEOGRAPHICAL AREA	WSC	WSC	WSC	WSC	WSC	Pac	Pac	Pac
UTILITY	Okla G&E	Okla G&E	Houston L&P	El Paso Elec	El Paso Elec	LA Dept W&P	LA Dept W&P	LA Dept W&P
STATION	Mustang No 1, 2	Arbuckle No 1	Greens Bayou	Rio Grande	Rio Grande	Valley No 1, 2	Valley No 3, 4	Valley (Misc)
Init Mw/units	113/2	31.8/1	230/2	49/3	49/3	200/2	312/2	512/4,
Ult Mw/units	.....	.....	3	6	6	-/4	-/4	.....
Init operation	-/50, 51	/53	3/53	-/29	-/29	8/54	-/55	8/54
Steam pressure, psi	850	850	1450	420	900	1450	1800	.....
Superheat/Reheat, F	900/-	900/-	1005/-	750/-	900/-	1000/-	1000/1000	.....
Stream name	Lake, Wells	Wells	Well MU	Rio Grande	Rio Grande	City & Wells	City & Wells	City & Wells
Normal flow, cfs	.....	.....	.....	700	700	.....	.....	.....
Minimum flow, cfs	.....	.....	.....	7	7	.....	.....	.....
Pk Season str temp, F	.....	.....	.....	84	84	.....	.....	.....
Ruling wet bulb, F	75	75	78	60	60	60	60	60
TOWER DESIGN								
Spec'd water from cond, F	104	103.5	107.2	100	100	94.9	101	90
Spec'd water from tower, F	88.5	86.5	90	81	81	81	80	80
Spec'd water rate, gpm	47,500	60,000	160,000	80,000 (4 un.)	30,000	36,000 ea.	34,200 ea.	13,000
Temp reduction by tower, F	16.5	17	17.2	19	19	13.9	21	10
Spec'd wet bulb, F	77	75	76	60	60	70	70	75
Approach temp, F	11.5	11.5	14	12	12	11	10	5
Corresp'd'g cond vac, in. Hg	2.35	2.32	2.74	2.31	2.31	2	2	.....
Recirc into stream?	No	No	.....	Yes	Yes	.....	.....	.....
TOWER DIMENSIONS								
Init operating date	-/50, 51	-/53	3/53	9/51	3/54	Each 8/54	Each-/55	8/54
Length, ft/in	241	193	340	145 (ea.)	121	252	180	120
Width, ft/in	63	63	70	40	61	42	66	38
Height, ft/in	36/9	38/1	41	30.8	39	40	80	48
Evap surf, (W)ood (P)ipe	W	W	W	W	W	W (356,000)	W (475,820)	W (169,000)
Draft, (F)orced (I)nduced	I	I	I	I	I	I	I	I
Fan, total Hp/No	400/8	600/8	1892/26	1280/32	480/8	272/7	404/10	144/4
Pump, total Hp/No	1000/2	1400/2	3436/4	1050/3	600/1	560/1	760/1	215/2
Est'd hr o,er per yr	8,300	8,300	8,700	.....	.....	8,000	8,000	8,000
COSTS (dollars)				Note (5)		(All towers included below)		
Concrete basin	93,200	58,200	.....	110,000			448,000	
Tans pumps wir'g, pip'g etc	376,160	425,300	.....	incl			2,305,000	
Tower only	216,400	250,200	.....	Lnl			1,797,000	
Total for installation	687,900	743,700	.....	1,000,000			4,500,000	
Dollars/kw unit net cap	13.80	9.28	.....	20.40			8.98	

Notes continued

5. Costs do not include wells, treatment or circulating water piping systems.

6. North main 75 Mw unit not affected by stream flow.

7. Cooling tower item covers fans, pumps, wiring, piping, etc; lighting $7,896; chlorine house structure, $7,771, equipment,

Comparatively few plants recirculate the water into the stream for supplementary mixing and cooling. In fact most of the reported plants have closed circuit systems with make-up water supplied only from well or city-water supply.

Temperatures . . . Temperatures of water fall within comparatively narrow range. Thus water from the condenser averages 101 F with spread from 90 to 115 F. Water after cooling averages 855 F with spread from 71 to 92 F. This results in an average temperature reduction of 15.5 degrees before cooling water is returned to the generating station condensers.

Average wet bulb temperature is 71.5 F with spread from 55 F to 80 F. In conjunction with the average temperature of the water from the tower the so-called approach temperature is thus, on the average, 13 degrees. The lowest reported approach given in survey returns is 5 degrees and the highest 30 degrees.

Vacuum . . . Vacuum averages 2.26 in. with spread from 1.5 to 3.5 in.

Objective of a cooling tower is to provide relatively cold water to condense the steam to a desirable vacuum. The better the vacuum the better the thermal efficiency of the plant. One would therefore expect to find costs per kw rising substantially if effort is directed at establishing a superior vacuum. Actually this is far from the facts. A plot shows little more than a gun-shot spatter of points. The most

In 52 Power Plants in the United States

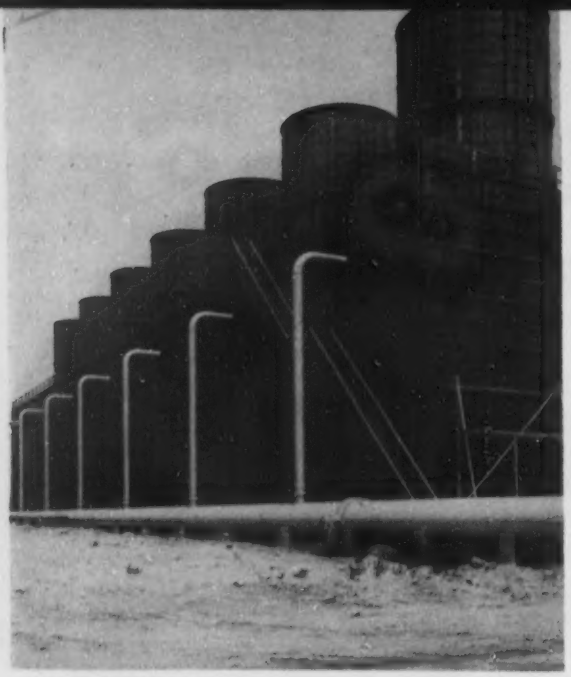
24	25	26	27	28	29	30
Pac	Pac	Pac	Pac	Mtn	Mtn	Mtn
So Cal Ed	Pacific G&E	Pacific G&E	Glendale—PSD	Salt River PD	Ariz PS	PS of New Mex
Etiwanda	Kern No 1	Kern No 2	Glendale No 1	Kyrene No 1, 2	Saguaro	Person
280/2	60/1	80.1	60/3	110/2	200/2	23/1
-/4	.....	.....	-/4	-/4	-/4	-/4
7/53	5/48	6/50	3/41	6/52	7/54	11/52
1800	1350	1350	850	850 & 1280	1450	850
1000/1000	925/-	925/-	900/-	960 & 900/-	1000/-	900/-
MWD Aquad.	Well	Well	Well	Westrew Can.	Wells	.....
150±	.....	.....	.....	300	.....	.....
65±	.....	.....	.....	0	.....	.....
77	.....	.....	.....	77	.....	.....
58	70	75	.....	65	70	.....
2 Towers, ea.						
91	105	105	96.23	106 Max	102.6	94.6
72	91	90	80.00	85	86	80
70,000	37,000	36,667	19,700	53,900	70,480	21,000
19	14	15	15.23	21	16.6	14.6
58	70	75	70	65	70	65
14	.....	.....	10	20	16	15
1.6	3	3	2	3 Max	1.5	1.5
No	.....	.....	.....	Can be	No	No
2 Sec., ea.						
7/53	5/48	12/49	11/53	12/52	7/54	.....
145	225/6	234	97/6	146	241	73
37/10	20/6	32	65/6	63	63	63
44/6	24/3	29	39/3	38	34/1	32
W	W (20,300)	W (7,168)	W	W	W	.....
I	F	I	I	I	I	I
344/8	273/14	308/7	240/6	280/6	500/10	235/3
1650/2	1200/3	1850/2	490/2	1000/4	2000/2	400/2
8,000	.....	.....	8,000	800	7,900	8,400
Note (11)			Note (12)	Note (13)	One of 2	.....
153,400	185,000		62,150	31,800	64,040	10,000
1,166,970	215,000		65,000	299,200	458,000	80,000
892,500	610,000		114,650	135,600	200,000	67,000
2,212,870	980,000		241,800	466,600	722,000	127,000
5.85	7.00		12.09	4.24	7.22	5.75

$5,794; basic cost included foundation and is high because of location on inclined terrain.

8. Does not include 12 ft stacks.

9. Tower cost includes fans; $310,000 item is for 2 wells and discharge piping.

10. Four towers for condensers, fifth for misc. cooling water



SEVEN-CELL COOLING TOWER at Valley Steam Plant of Los Angeles Dept. of Water and Power

that can be said is that the cooling towers designed for moderate values of vacuum are slightly less expensive than those that have been stipulated for better vacuum performance.

What can safely be said is that other factors—terrain, source and temperature of water, elevations and heads—have more to do with cost of the cooling tower than the primary objective, namely, to condense the steam and produce a low exhaust pressure for the turbine.

Fan and Pump Power . . . Requirements for water cooling tower operation vary widely, as much for the fans as for the pumps. A spread might well be expected for the pumping requirements in view of difference in

Statistics of Cooling Tower Installations

NUMBER	31	32	33	34	35	36	37
GEOGRAPHICAL AREA	Mtn	Mtn	Mtn	Mtn	Mtn	Mtn	Mtn
UTILITY	Southwestern PS	So Cal Pwr	Tucson GELP	Tucson GELP	Tucson GELP	Tucson GELP	Utah P&L
STATION	Carlsbad No 4	Rocky Ford	DeMoss Petrie (1)	DeMoss Petrie (2)	DeMoss Petrie (3)	DeMoss Petrie (4)	Carbon
Init Mw/units	20.6/1	7.5/1	12/3	12/3	25/2	50/2	66
Ult Mw/units	.....	.....	4	4	4	4	.....
Init operation	12/52	4/51	6/49	6/49	6/49	6/49	12/54
Steam pressure, psi	600	600	600	600	850	850	1250
Superheat/Reheat, F	825/-	830/-	825/-	825/-	900/-	900/-	950/-
Stream name	Pecos R	.....	Well MU	Well MU	Well MU	Well MU	Price R & Well
Normal flow, cfs	110	.....	.....	.....	.....	.....	.....
Minimum flow, cfs	35	.....	.....	.....	.....	.....	.....
Pk Season air temp, F	75	.....	.....	.....	.....	.....	40
Ruling wet bulb, F	60	70	72	72	72	72	61
TOWER DESIGN							
Spec'd water from cond, F	91	96	96.5	96.5	96.5	96.5	102.5
Spec'd water from tower, F	78	82	80	80	80	80	82.5
Spec'd water rate, gpm	25,000	10,600	14,000	14,000	25,000	46,000	39,000
Temp reduction by tower, F	13	13	16.5	16.5	16.5	16.5	20
Spec'd wet bulb, F	70	70	72	72	72	72	60
Approach temp, F	8	13	8	8	8	8	22.5
Corresp'd'g cond vac, in. Hg	1.49	1.65	2.05	2.05	2.05	2.21	2.5
Recirc into stream?	Yes	No	.....	.....	.....	.....	No
TOWER DIMENSIONS							
Init operating date	.....	4/51	9/49	9/49	9/49	9/49	12/54
Length, ft/in.	181	85	121	121	121	181	145
Width, ft/in.	64	48	62	62	62	84	62
Height, ft/in.	26	29	26.8	26.8	34.2	61.3	.....
Evap surf, (W)ood (P)ipe	W	P (240 x 4 in.)	W	W	W	W	.....
Draft, (F)orced (I)nduced	I	I (18 ft)	I	I	I	I	I
Fan, total Hp/No.	450/6	180/1	200/4	200/4	200/5	600/12	225/6
Pump, total Hp/No.	600/2	240/1	300/2	300/2	600/2	1200/2	538/2
Est'd hr oper pr; yr	8,000	8,000	7,200	7,200	8,400	8,400	.....
COSTS (dollars)							
Concrete basin	48,806	8,544	.....	.....	.....	.....	.....
Fans pumps wir'g, pip'g etc	45,000	11,606	.....	.....	.....	.....	.....
Tower only	143,953	48,507	.....	.....	.....	.....	.....
Total for installation	237,759	68,659	.....	.....	.....	.....	.....
Dollars/kw unit net cap	11.58	9.15	.....	.....	.....	.....	.....

Notes continued

requirements of station, cost are aggregate for all; heights are to fan decks.

11. Two identical towers; each has two identical sections.

12. Data and costs apply exclusively to third 20 Mw unit (1953).

pumping head due to terrain elevations and particularly whether the water comes from wells or from stream or pond.

Average fan power for 3408 Mw of capability runs at 8.8 hp per Mw. The spread is from 1.0 to 26, a spread-ratio of 26 to 1. All but one of the 52 plants uses induced draft.

Average pumping power for the same 3498 Mw is 19.2 hp per Mw. Here the spread is from 4.9 to 49 hp per Mw or a spread of 10 to 1.

Combined the powering of the water-cooling power amounts to 7.5 hp per Mw as a minimum reported value and 53.3 hp per as much for the fans as for the pumps. A Mw as a maximum. The mean value is 28 hp per Mw.

The Opening Picture—page 91

Seen through the open steel work of Valley Steam Plant of the Los Angeles Dept of Water and Power is the initial installation of what will ultimately be the largest cooling tower installation at any electric generating station in the U. S.

They are the towers for the first two of four generating units at Valley, which will ultimately require eight such towers as well as an auxiliary tower to dispose of heat from all equipment except condensers.

Main towers are of the induced draft type, having a total water flow of approximately 144,000 gpm and a design air flow of 12 million cfm.

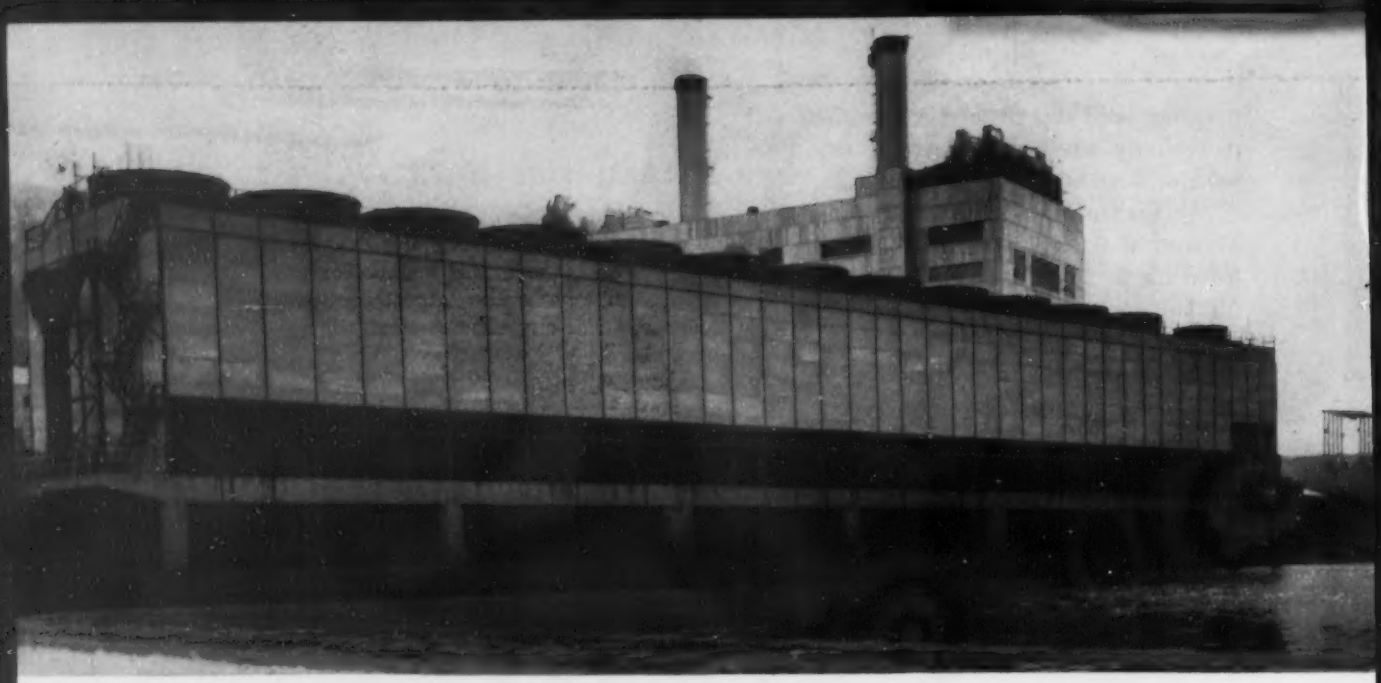
In 52 Power Plants in the United States

39	39	40	41	42	43	44	45
Mtn	Mtn	Mtn	ENC	ENC	ENC	ENC	ESC
Utah P&L	Utah P&L	Utah P&L	Col & SOE	Col & SOE	Col & SOE	Ill Pwr	Miss P&L
Gadsby No 1	Gadsby No 2	Gadsby No 3	E M Poston No 1, 2	E M Poston No 3	E M Poston No 4	Vermilion No 1	Rex Brown No 1
66/1	75	100	100/2	60/1	80/1	75/1	33/1
3	3	3	-/4	-/4	-/4	-/4	.....
9/51	12/52	12/55	9/49	1/54	1/54	3/55	8/48
1250	1450	1450	1250	1200	1250	1450	920
950/-	1000/1000	1000/1000	950/-	950/-	950/-	1000/1000	905/-
Jordan R.	Jordan R.	Jordan R.	Wells	Wells	Wells	Vermilion R	Wells
142.66	142.66	142.66	.....	.....	.....	90 mean	.....
(Rights)	(Rights)	(Rights)	.....	.....	.....	1	.....
40	40	40	.....	.....	.....	.....	.....
64	64	64	.....	.....	.....	76	.....
95	95	97	103	104.8	104.8	101.5	106.6
84	84	84	89	89	89	86	91
70,000	70,000	82,000	86,000	55,000	55,000	53,000	31,000
11	11	13	14	15.8	15.8	15.5	15.6
63	63	63	75	75	75	76	78
21	21	21	14	14	14	10	13
1.5	2.5	2.5	3.5	3.5	3.5	1.5	.....
No	No	No	No	No	No	No	No
9/51	12/52	5/55	1/54	1/54	1/54	3/55	8/48
261	225.5	301	320	189	189	217	97/6
51	49.5	43.3	65	63	63	63	65/6
.....	.....	.....	32	34	34	38/1	35/3
.....	.....	.....	W	W	W	W	W
I	I	I	I	I	I	I	I
406/7	568/14	392/10	1200/20	420/7	420/7	440/9	360/8
923/2	1000/2	330/3	1800/4	1400/2	1400/2	555/2	600/1
7,537	8,268	.....	8,000	8,000	8,000	8,760	8,280
			Note (14)			Note (15)	
46,500	92,800	.....	98,000	55,000	53,000	64,500	17,500
Incl	Incl	.....	61,000	34,000	37,000	22,190	20,000
179,500	198,000	.....	271,000	153,000	171,000	185,300	82,668
224,500	260,800	.....	430,000	242,000	260,000	281,990	120,168
3.41	3.48	.....	4.30	4.03	4.33	3.75	3.64

13. Costs are "material and labor"; towers include fans.

14. Fan motors combined with wiring and controls; induced-draft fans included with towers.

15. Artificial reservoir storage (700,000,000) pumped during high stream flow will furnish plant and tower makeup for units No. 1 and No. 2 (175,000 kw) during seasonal periods of low stream flow.



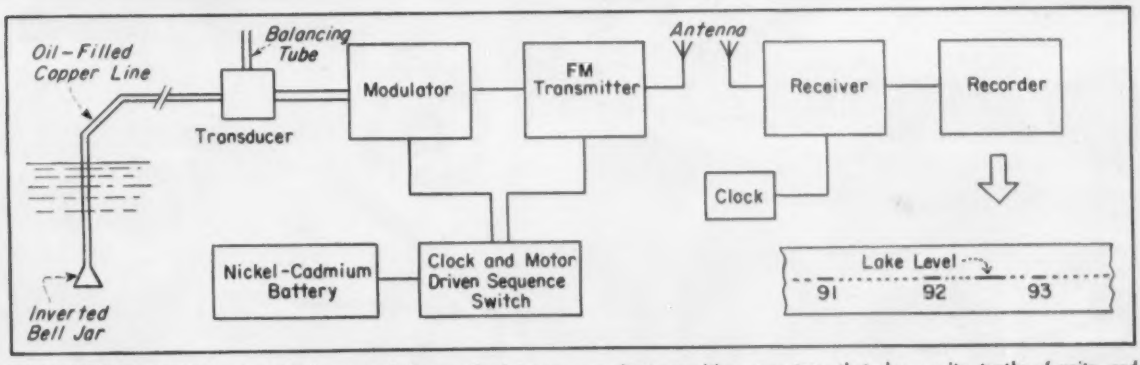
SHAWVILLE COOLING TOWER of Pennsylvania Electric Co supplements river water during dry periods. Tower is capable of dropping 52,500 gpm from 115 to 85 F with a wet bulb reading of 75 F. Permits 137.5Mw generation each from two turbines at low river flow

Statistics of Cooling Tower Installations

NUMBER	45	47	48	49	50	51	52
GEOGRAPHICAL AREA	ESC	ESC	ESC	ESC	SA	MA	MA
UTILITY	Miss P&L	Miss P&L	Miss P&L	Kentucky U	Duke Pwr	Penna Elec	Scranton Elec
STATION	**Rex Brown No 3**	**Rex Brown No 3**	**Natchez**	**Pineville No 3**	**Lee**	**Shawville**	**Suburban No 1**
Init Mw/units	44/1	66/1	66/1	30/2	300/2	250/2	25/1
Ult Mw/units	.....	.....	.....	-/3	-/3	-/4	.....
Init operation	12/49	3/51	1/51	7/52	-/51	3/54	-/48
Steam pressure, psi	920	1475	135	450	1250	1800	1250
Superheat/Reheat, F	905/-	955/-	955/-	900/-	950/950	1050/1000	1000/-
Stream name	Wells	Wells	Wells	Cumberland R	Saluda	Susquehanna	City
Normal flow, cfs	.....	.....	.....	1200	550 Aver	400	.....
Minimum flow, cfs	.....	.....	.....	6.1	100	85	.....
Pk Season str temp, F	.....	.....	.....	85	80	75	.....
Ruling wet bulb, F	.....	.....	.....	70	.....	75	.....
TOWER DESIGN							
Spec'd water from cond, F	106.6	106	106	100	114	115	111
Spec'd water tower, F	91	90	90	84	91	85	91
Spec'd water from rate, gpm	43,000	49,000	49,000	30,000	50,000	52,500	18,150
Temp reduction by tower, F	15.6	16	16	16	23	30	20
Spec'd wet bulb, F	76	76	76	76	75	75	66
Approach temp, F	13	14	14	8	16	15	.....
Corresp'd'g cond vac, in. Hg	.....	2.5	2.5	2.38	2.91	2.5	.....
Recirc into stream?	No	No	No	No	No	Yes	No
TOWER DIMENSIONS							
Init operating date	12/49	3.51	1/51	7/51	-/51	Each of 2 3/54	-/48
Length ft/in	216/9	160/0	160	131	161/6	313	145.5
Width, ft/in	53/5	64/0	64/0	68	65/6	56	49.5
Height, ft/in	30/0	34/3	34/3	38/1	34/3	45	30
Evap surf, (W)ood (P)ipe	W	W	W	W	W	W	W
Draft, (F)orced (I)nduced	I	I	I	I	I	I	I
Fan, total Hp/No	360/18	600/10	600/10	300/5	360/10	720/12	265/12
Pump, total Hp/No	1000/2	1200/2	1200/2	800/2	1200/2	1200/3	1080/3
Est'd hr oper per yr	8,280	8,280	8,280	8,700	400-2200	720	7,800
COSTS (dollars)							
Concrete basin	26,800	26,100	49,000	25,000	25,000	275,000	21,000
Fans pumps wir'g, pip'g etc	30,000	32,200	37,700	7,800	.....	250,000	15,400
Tower only	101,500	121,000	111,400	136,000	272,000	340,000	62,100
Total for installation	168,300	180,300	198,100	168,000	297,000	865,000	99,500
Dollars/kw unit net cap	3.83	2.73	3.00	5.60	2.97	7.06	3.97

Notes continued

16. Tower supplements stream flow for entire plant; its capacity is sufficient for requirements of one 100 Mw unit.



TELEMETERING SYSTEM automatically sends daily record of water level at remote lake to a central point, 35 miles away. Record is made on electro-sensitive paper tape that shows units, tenths of units, and longer marker pulse, the center of which is lake level

Lake Level Telemetered Automatically

G. M. KEYSER, Electrical Research Engineer, Hydro-Electric Power Commission of Ontario, 620 University Ave., Toronto, Ont.

An unattended radio telemeter system developed by the Hydro-Electric Power Commission of Ontario automatically transmits water level data from a remote lake to a central point. Accurate to within 1 in., it permits load forecasting without the need of men traveling to measure lake level.

Equipment at the lake consists of:

1. Differential-type pressure transducer for converting hydraulic pressure to an electric signal.
2. Modulator having an audio-tone generator and a multiple-contact motor-driven switch that provide the transmitted reference pulses and a marker pulse.
3. Control equipment.
4. Battery.
5. And the transmitter.

At the receiving end a radio receiver demodulates the transmitted signal, and audio pulses are automatically recorded by an electro-sensitive tape recorder.

Lake level is sensed by pressure on oil in an open, inverted bell jar mounted on a steel tripod deep enough below the water surface to be unaffected by ice. Pressure is transmitted by an oil-filled copper tube to a pressure bellows in the transducer on the shore. An adjustable oil column connected to the low-pressure side of the bellows compensates for the static head of water.

Pressure bellows is linked to the moving contact of a potentiometer that is connected as a bridge circuit with another potentiometer, located 500 ft away at the most favorable antenna site. Moving contact of the latter potentiometer is motor driven and connects through an amplifier to a relay that controls timing of the marker. Power to the bridge is supplied from a low-frequency source in the modulator.

The relay closes momentarily when the bridge is balanced, which occurs when the motor-driven contact is electrically opposite the moving contact on the transducer's potentiometer. While the relay is closed, contacts of a multiple-contact motor-driven switch are shunted.

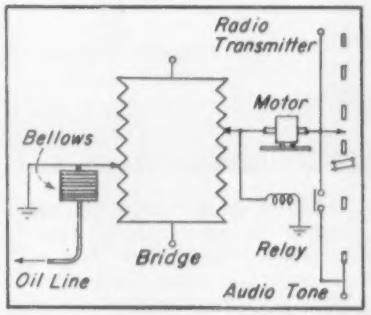
The multiple-contact switch, driven by the same motor that moves the potentiometer contact, controls duration of reference pulses from the 2,600-cps audio-tone generator to the 10-w, 153.71-Mc transmitter. During each operating period 100 short reference pulses are transmitted. Every tenth pulse is slightly longer to indicate units. The marker pulse is a still longer pulse and its timing is controlled by closing of the relay.

In operation, an electrically wound clock, supplied from the battery, closes once a day for a 2-min period. Operation is then controlled by a set of program switches operated from cams on the motor shaft. Small switches close in sequence to connect the tube filaments and vibrator supply followed by a 10-sec audio tone to start the recorder paper drive at the receiver. Another switch short-circuits the clock contact for two revolutions of the potentiometer contact.

The receiver is turned on by a time clock 15 min before transmission of the actual intelligence. Received pulse signals are demodulated, filtered, and amplified to operate a sensitive relay that momentarily closes a dc supply to the automatic recorder.

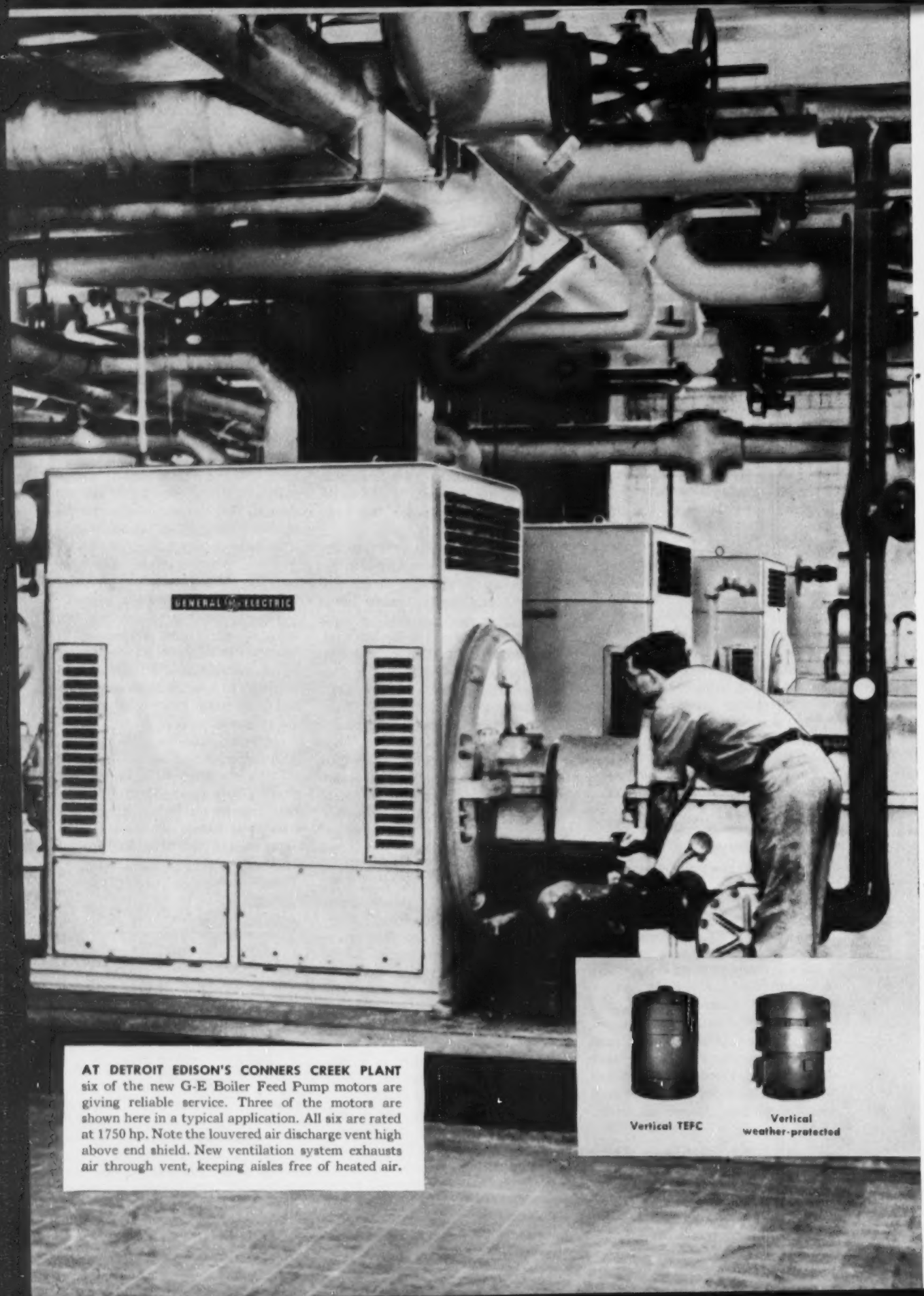
Current pulses from the receiver relay correspond to audio tones supplied to the transmitter. Pulses are recorded on a 16-mm electro-sensitive paper tape by current passing through a fine wire stylus. Mid-point of the longer marker pulse should be used as the proper reading of lake level.

(*Continued on page* 102)



TRANSDUCER AND MODULATOR circuit shows how pressure bellows, bridge, relay, and multiple-contact switch modulate transmitter

Adapted from an article entitled Water-Level Telemeter that was published in the Hydro-Electric Power Commission of Ontario's Ontario Hydro Research News.



AT DETROIT EDISON'S CONNERS CREEK PLANT six of the new G-E Boiler Feed Pump motors are giving reliable service. Three of the motors are shown here in a typical application. All six are rated at 1750 hp. Note the louvered air discharge vent high above end shield. New ventilation system exhausts air through vent, keeping aisles free of heated air.

Vertical TEFC

Vertical weather-protected

General Electric Boiler Feed Pump Motor Features Unique Ventilation System

Well-integrated bearing design means longer motor life

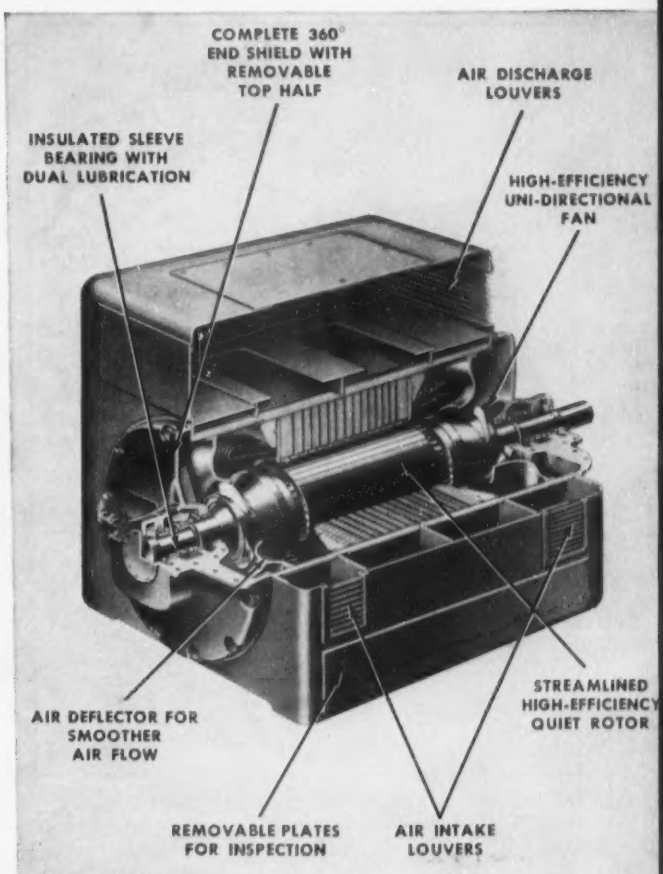
General Electric's Boiler Feed Pump motor, field proved in power stations across the country, has a revolutionary ventilation system which helps prevent recirculation of heated discharge air. Air, drawn in through the sides of the motor, is discharged high over the pump and away from aisles and employees. This means motors can be mounted closer together and still get proper ventilation.

QUIET OPERATION is assured because the G-E Boiler Feed Pump motor is designed for minimum inherent noise. In addition, these motors can be modified to meet specific sound level requirements.

LONGER BEARING LIFE means motors last longer, and the bearing system of G-E Boiler Feed Pump motors is designed for the reliable year 'round operation so vital to your industry.

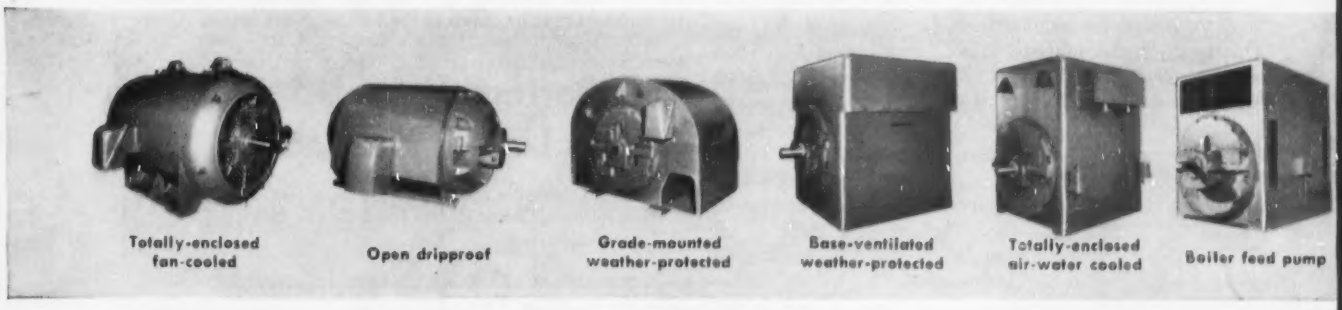
- Dual lubrication system, both ring and force-flood, assures thorough lubrication and cool bearing oil.
- Amply proportioned bearings provide even distribution of stress. Bearings are insulated to prevent circulation of shaft currents.
- Soft-metal labyrinth seals are carefully machined to keep dirt out, oil in.

WHATEVER YOUR NEEDS in power station motors, General Electric can furnish a complete line—a wide variety of designs and enclosures to meet every operating condition. For more information on G.E.'s Boiler Feed Pump motor (Bulletin GEA-5813) or any of the complete line of power station motors consult your nearest Apparatus Sales Office, or write General Electric Company, Section 830-11, Schenectady 5, N.Y.


COMPLETE 360° END SHIELD WITH REMOVABLE TOP HALF
AIR DISCHARGE LOUVERS
INSULATED SLEEVE BEARING WITH DUAL LUBRICATION
HIGH-EFFICIENCY UNI-DIRECTIONAL FAN
STREAMLINED HIGH-EFFICIENCY QUIET ROTOR
AIR DEFLECTOR FOR SMOOTHER AIR FLOW
REMOVABLE PLATES FOR INSPECTION
AIR INTAKE LOUVERS

CUTAWAY OF NEW G-E BOILER FEED PUMP MOTOR

A COMPLETE LINE OF MOTORS FOR POWER STATION SERVICE



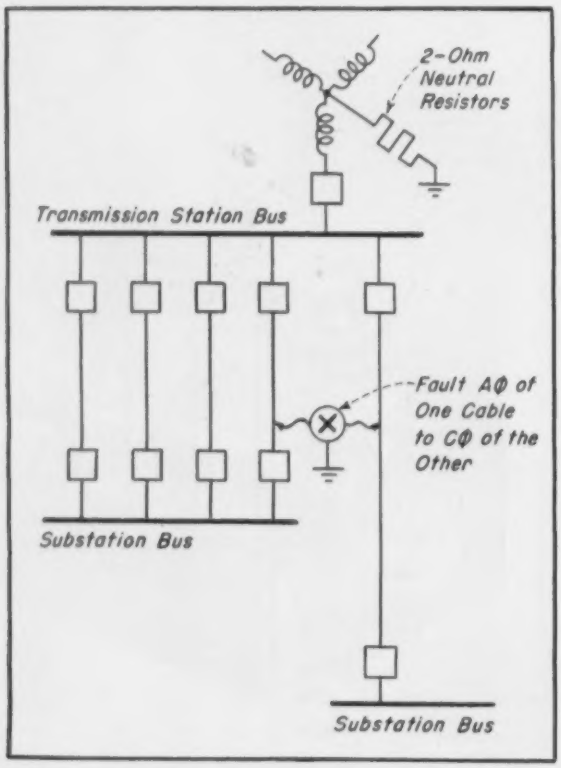
GENERAL ELECTRIC

Lake Telemetering

(*Continued from page* 99)

Modulator circuits are designed so that electrical changes or failure of tubes do not affect accuracy of the reading. Low motor speed acts only to lengthen the chart record and indicate low battery voltage or low temperature. Gain changes of the amplifier, for relay control in the modulator, affect only the length of the water-level tone and not its position.

Successful operation during the winter of 1953 established the feasibility of the unattended radio telemeter exposed to low temperatures. Damage caused to part of the equipment by a severe electrical storm interrupted operation recently. Such occurrences should be infrequent.



TYPICAL INSTALLATION shows location of the cable fault that opened all circuit breakers to cables at the transmission station bus

Ground Relays Set for Simultaneous 1-Ph Faults

JOHN M. SHOWMAN, Relay Engineering Section, Cleveland Electric Illuminating Co, Cleveland, Ohio

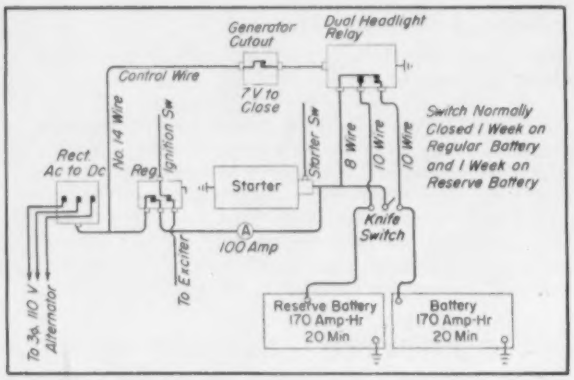
Ground relay applications on parallel cable systems are analyzed today for simultaneous phase to ground faults. This practice was initiated after a distribution substation supplied by several parallel 11.5-kv cables was shut down by instantaneous tripping of all ground relays at the source end.

Since improper relay action was indicated, a rather thorough investigation and analysis was made of this case of trouble. Cause was simultaneous failure of A-phase in one of the parallel cables and C-phase of a cable in an adjacent duct. The second cable served a different substation but originated at the same source.

Fault current flowed in only one phase of each cable, thus, looked like line-to-ground current to each set of relays. Copper conductors throughout most of the path permitted the current to exceed customary ground-fault currents. Because it flowed in A-phase of all the parallel cables in excess of the conventional trip settings, it tripped them all.

Short circuit calculations are now modified to consider this type of fault. Calculations are made on the basis of a phase-to-phase fault because the zero sequence component of the ground current usually proves to be negligible. Since the 2-ohm station neutral resistor is in only the zero sequence circuit, it can be dropped from the 2-circuit calculations. Impedance values are selected for conductor spacing equivalent to the geometric mean distance among the several adjacent ducts. This impedance value is 0.095 ohm per 1,000 ft of 11.5-kv, 4/0 cable compared with 0.37 ohm per 1,000 ft zero sequence impedance. Currents calculated for 2-circuit faults run considerably higher than those calculated for single circuit grounds.

Ground relay instantaneous trips are set at about 150% of the current calculated for 2-circuit faults. Further precaution is to ascertain that trip settings are above this fault current when one of the parallel cables is out of service.



TWO-BATTERY HOOK-UP saves emergency calls to replace battery for starting the truck engine in the field when one battery is dead

Two-Battery Hook-Up Serves Line Truck Radio

FRANK D'LUHOSCH, Assistant Superintendent, Buildings and Transportation, Central Hudson Gas & Electric Corp., Poughkeepsie, N. Y.

A three-phase alternator, rectifier and regulator system, used for charging a dual battery installation on larger line trucks, has given exceptionally good results for Central

(*Continued on page* 106)

WATCH IT BEING INSTALLED

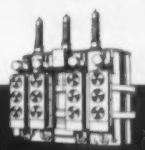
Two big General Electric power transformers recently made news and you can watch them making it in the 23-minute, G-E color movie, *Power in Place.*

This documentary film shows the whole installation process in clear detail, from sliding the transformer off the flatcar to the assembly of bushings and accessories. Everyone who installs transformers—or would like to see it done—can gain some helpful ideas by watching the installation of a 145,000-KVA unit at the Oak Creek Station of Wisconsin Electric Power Company, and a 135,000-KVA unit at the Delta Station of the Mississippi Power and Light Company. For full information about this educational G-E film, just contact your nearest G-E Apparatus Sales Office. General Electric Company, Schenectady 5, N. Y.

421-20

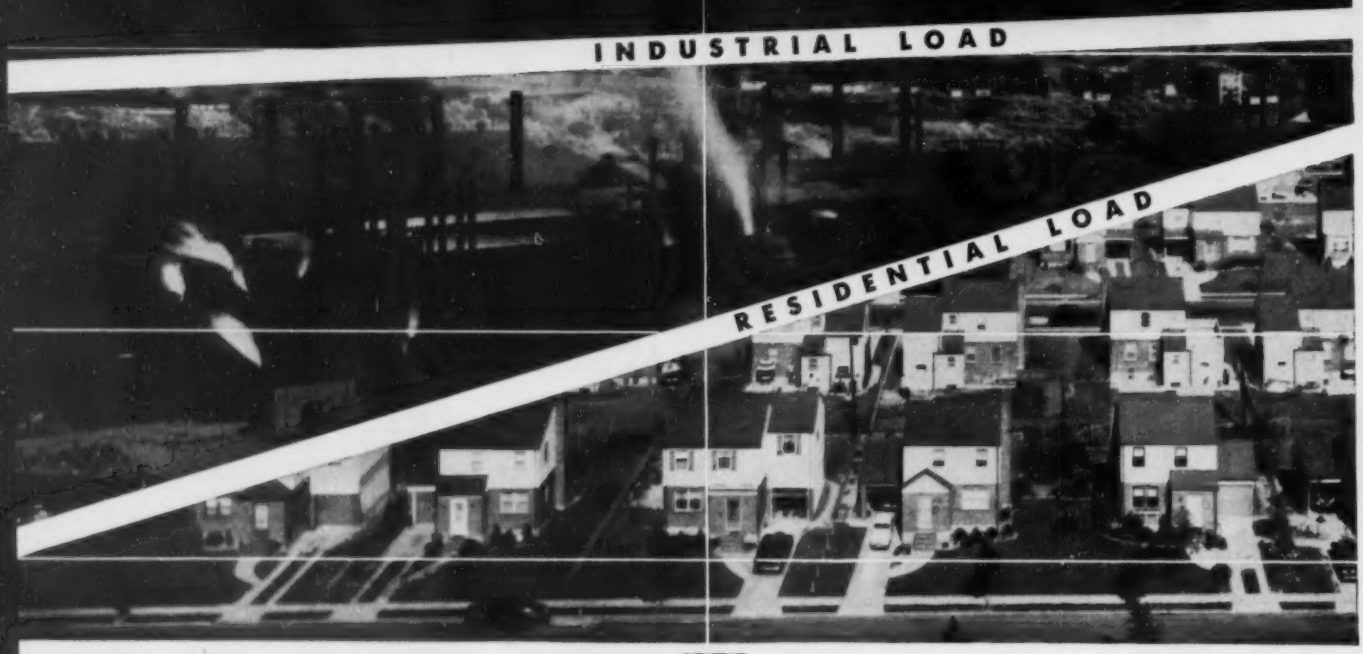
Progress Is Our Most Important Product

GENERAL ELECTRIC



Power Transformer NEWS

Residential Load Will Equal Industrial Load



1954

Here's the most economical way

Use G-E Unit Substations to reduce system investment

Add capacity to handle your steadily growing residential market and do it the most economical way with G-E Unit Substations.

No excess investment is needed because you buy no more capacity than is actually required. That means economy today—plus quick and easy expansion to meet the demands of tomorrow.

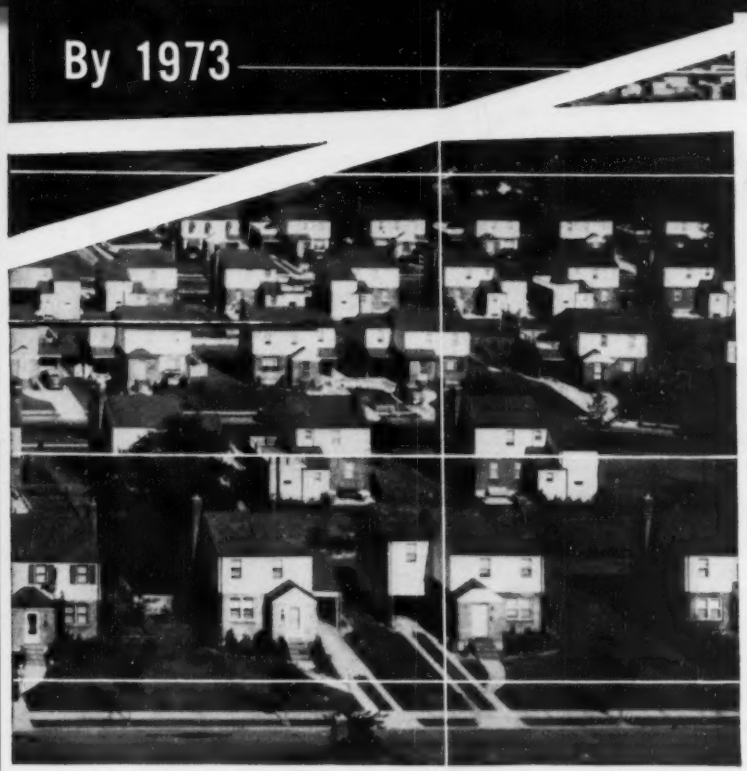
G-E Unit Substations can simplify the problems of expansion as requirements increase. Advance planning and proper substation selection, for example, permit you to expand a radial system into a network system.

Have capacity available when you need it by ordering G-E Unit Substations in advance on the basis of predicted load growth. Then, when your load grows, select sites where capacity is needed and your substations are ready to be installed.

"How to Reduce System Investment" (Bulletin GEA-5847) will help you plan for economical system expansion. It discusses system planning and reveals how other utilities are handling rapidly growing loads. For your copy, write General Electric Company, Section 512-3, Schenectady 5, N. Y.

Progress Is Our Most Important Product

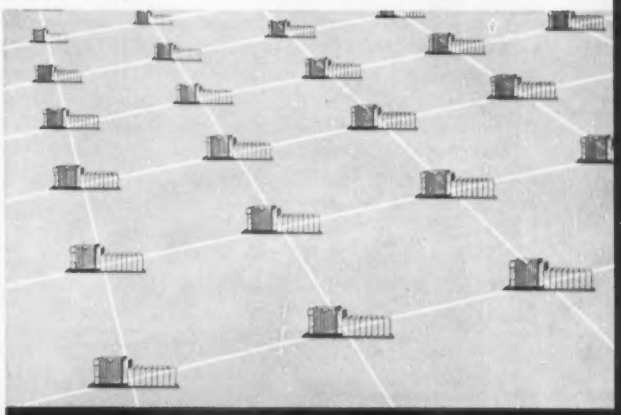
GENERAL ELECTRIC



RESIDENTIAL LOAD IS GROWING rapidly, and is expected to equal industrial load by 1973. Utilities can meet their residential distribution demands yet trim system investment by advance planning with G-E Unit Substations.

to grow with your residential load

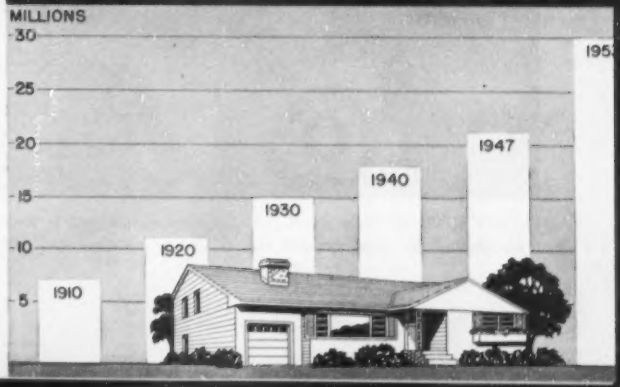
LOCATIONS FOR UNIT SUBSTATIONS are "on the mile every mile" to economically serve residential areas. By properly locating small unit substations for expansion into such a system, utilities can economically grow with increasing demands and provide residential customers with economical power and maximum service continuity.



EVERY MILE ON THE MILE

POPULATION GROWTH in the U.S. since 1947 has been 11%—population in the suburbs has grown 43%. Since 1941 the average kilowatt-hours use per residential customer has doubled every 10 years and is expected to double again in the next decade. This fast-growing suburban growth trend has been going on for a long time—is expected to last indefinitely.

HOW THE SUBURBANITES MULTIPLY



Battery Hook-Up

(*Continued from page* 102)

Hudson Gas & Electric Corp. No service trips have been made from the garage to replace dead batteries during the past year's trial period. In addition, continuous truck engine idling is no longer necessary to keep the batteries charged.

The second battery and the alternator system were added because of the increased power requirements for two-way radios. If the battery supplying the radio becomes weak while the truck is parked and the engine turned off, a knife switch is manually operated to disconnect the weak battery and connect the other on the circuit. The alternator with a selenium rectifier replaces the conventional dc generator and provides greater charging capacity. It maintains the charge on either battery (depending on knife switch position) during normal engine operation or short idling periods, when required.

When each truck is garaged for the night, the driver opens the knife switch on the hook-up. This de-energizes the electric system, making it impossible for either battery to run down over night if the radio, ignition or heater is inadvertently left on. The garage attendant checks the batteries and recharges them from garage facilities, or changes them as required, for service the next day.

Using Helicopter Speeds Repair Work in Mountains

Time and labor were saved when a helicopter-supported task force repaired a storm-damaged transmission line high in mountainous country southwest of Ft. Simcoe, Wash. Linemen of Pacific Power & Light Co were unable to reach the remote spot by truck because of snow-blocked roads.

With the help of a helicopter, the trouble was spotted, an approach route laid out, and a synchronized equipment drop made. The line crew drove to within 3½ miles of the trouble. From there they hiked across country carrying their personal tools. At the trouble spot they were met by the helicopter which dropped a new cross arm for the damaged two-pole structure along with heavy tools and other equipment. The job was completed in 4 hr.

"It's too early to put in an application for 'helicopter patrolman' ", said PP&L's line superintendent Phil Clark. "But you can't beat them when you have trouble in the mountains."

FLYING SUPPLIES for a storm-damaged transmission line in mountains blocked by snow speeded repairs and saved time and labor

NEAT AND COMPACT in appearance is this open-delta bank. Pole mounting can save up to $28 per installation over the use of cross arms

Pole Mount Open Delta Banks

VERN STILWELL, Line Working Foreman, Idaho Power Co, Payette, Idaho

Pole-mounting of open-delta transformer banks provides substantial savings and results in clean and compact appearing installations on the lines of Idaho Power Co. Savings in material alone for banks up to 30 kva are about $20 per installation over the use of cross arms; above 30 kva, savings amount to about $28 per installation. From the safety angle, pole mounting is considered just as safe as one transformer mount for single-phase service.

In the installation pictured, mounting holes for the transformers are 54 in. below the line arm. Where the switch arm is omitted, holes need be but 42 in. below the line arm. Holes are bored 11½ in. apart on one quarter of the pole. On the opposite quarter, they are the same distance apart but 2 in. lower. Transformers are attached with two 10-in. through bolts each. The service rack may be located as shown or under the smaller transformer.

Phase leads in the primary bus are looped to provide sufficient clearance. Neutrals are connected directly to the pole ground which is covered with ground mould. Transformers are positioned on the pole to allow room for addition of a third transformer.

(*More How To on page* 114)

Look into
REVERE EXTRUDED SHAPES
—it may pay you as it did Westinghouse

When engineers of the Westinghouse Electric Corporation, East Pittsburgh, Pa., designed an inner-cooled generator rotor, the problem of making the hollow rotor coils arose. It was decided to make these out of two channel sections, butted together. Such channels could be made by milling solid copper bar, but Westinghouse knew how expensive such a process is. Could Revere produce the channels by the extrusion process? We thought we could, and after close collaboration with Westinghouse engineers, the various design and extrusion requirements were finalized. The channels are extruded, drawn, annealed, and then given a final draw.

Generators containing these special rotors are cooled by forcing hydrogen through the inner-cooled conductors at 30 psig. Because the heat is picked up directly from the copper, cooling performance is greatly increased over former designs. As a result, generator output can be approximately doubled without increasing physical size. To put it in other ways, output is increased per pound of generator weight and per pound of fuel.

Extruded shapes can save a great deal of machining time and money, and make new ideas commercially practical. Come to Revere for them in copper and its alloys and aluminum alloys.

REVERE

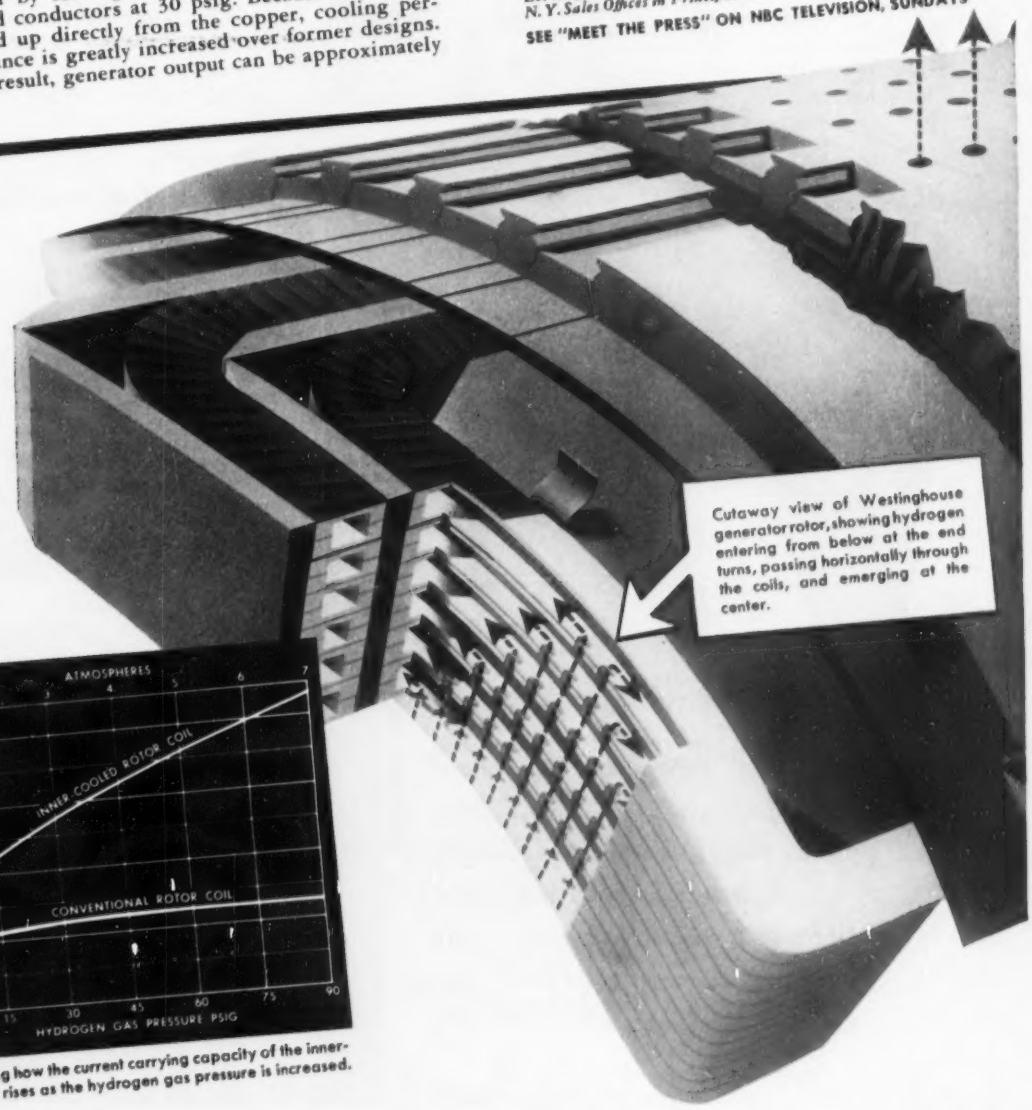
COPPER AND BRASS INCORPORATED

Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

SEE "MEET THE PRESS" ON NBC TELEVISION, SUNDAYS


Cutaway view of Westinghouse generator rotor, showing hydrogen entering from below at the end turns, passing horizontally through the coils, and emerging at the center.

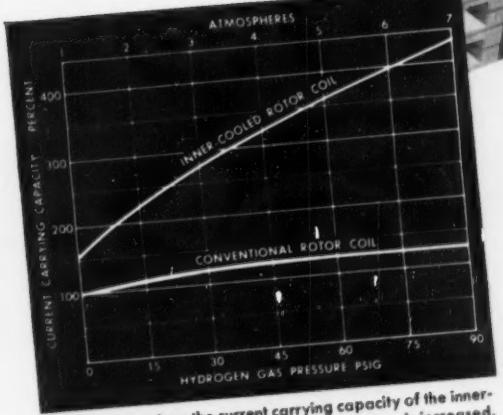


Chart showing how the current carrying capacity of the inner-cooled rotor rises as the hydrogen gas pressure is increased.

IMPACT protection

For complete electrical and mechanical specifications covering the Pinco 1060 Suspension Insulator, refer to page 65, Pinco Catalog No. 49. If you don't have a copy—write us or contact the Joslyn Mfg. & Supply Co., office in your locality.

PINCO
INSULATORS

RIGHT ON THE JOB—

is built into Pinco insulators too!

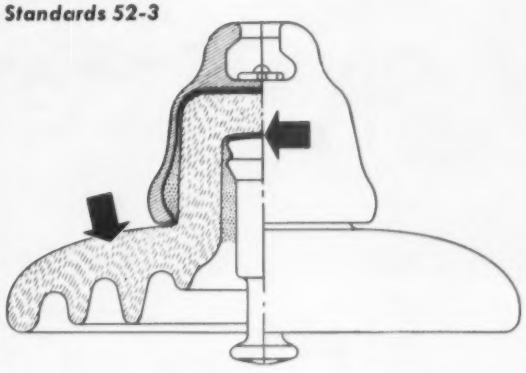
If we were to ask you what qualifications a good suspension unit should have in addition to its accepted ratings (M & E Strength; Flashover; Leakage Distance; etc.), chances are you'd say—*its ability to resist breakage in construction and on the line.* And you'd be right! For unless an insulator is so designed and constructed to withstand impact blows, it is not giving you the most for your insulator dollar.

Now let's take a look at this Pinco 1060 Suspension unit and see what steps have been taken to *increase* its resistance to impact. First of all there is the inherent higher strength of Pinco "wet plastic" porcelain. Important too, is the *rugged design of the porcelain body* wherein the proper distribution of porcelain at the critical points *plus* beaded edges on all external skirts produce a huskier section of sufficient strength to provide *extra* needed protection. Other contributing factors are the accurate glaze "fit" . . . the resilient pad between porcelain and top end of pin and, of course, Pinco's careful assembly alignment.

You can't see all of these Pinco features of course, but they're there just the same . . . "built-in" features which provide for better all-around "right-on-the-job" performance. Service records prove this statement. So if you're interested in lower replacement costs and longer line-life . . . put up Pinco *to be sure!*

The Pinco 1060 Suspension Insulator Conforms to EEI—NEMA Standards 52-3

Pinco Insulators of every type are continually subjected to tough laboratory tests approximating all possible conditions encountered in actual service. Typical of these is this routine test of impact strength which is made on random samples from production . . . another example of Pinco's careful watchfulness over every detail from design to finished product.



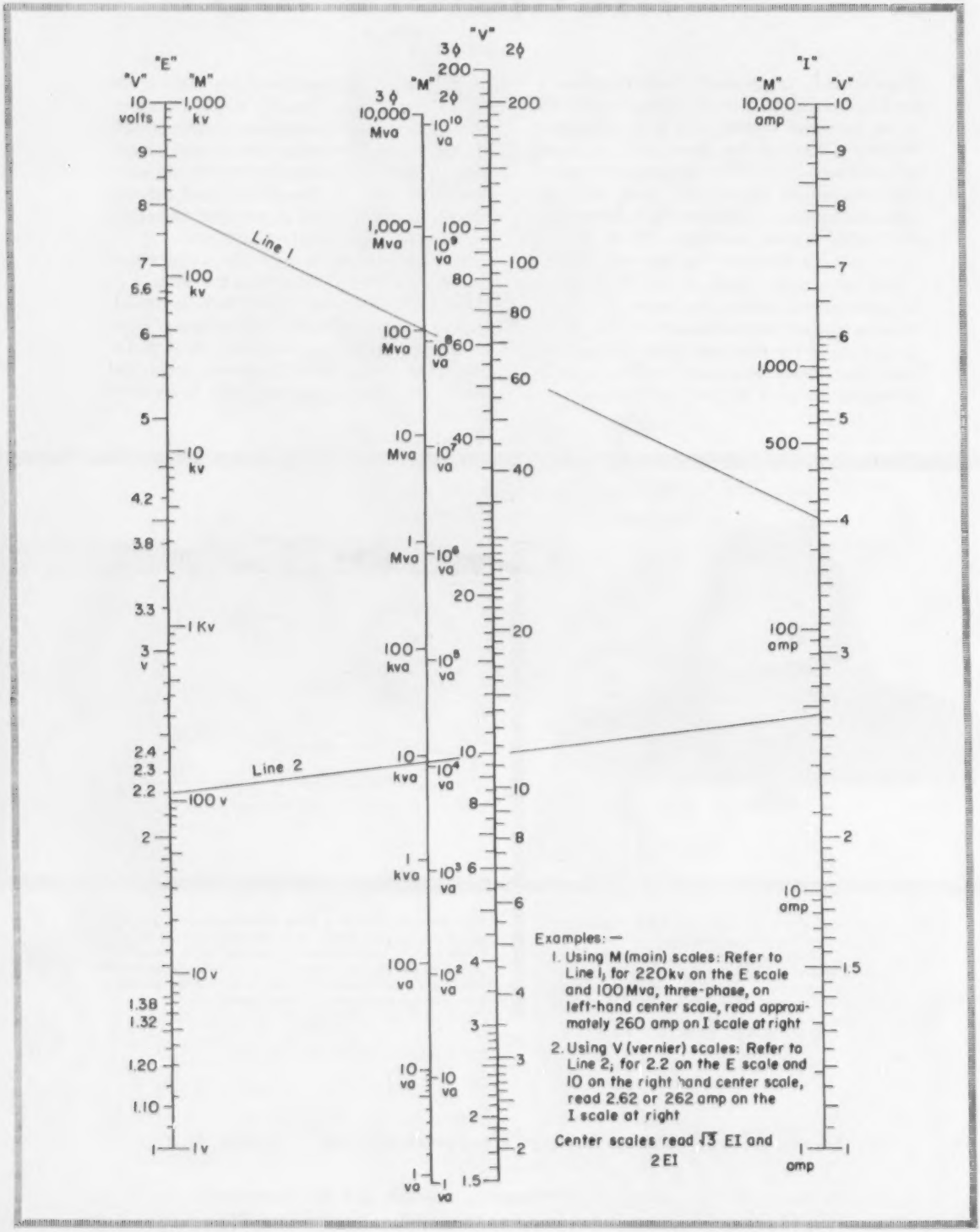
This sectional view of a Pinco 1060 Suspension Insulator shows its rugged design characteristics and husky porcelain section. Note location of resilient "shock absorbing" pad between pin and porcelain . . . another feature built into every Pinco Suspension Unit to protect the porcelain from damage by impact on the pin end.

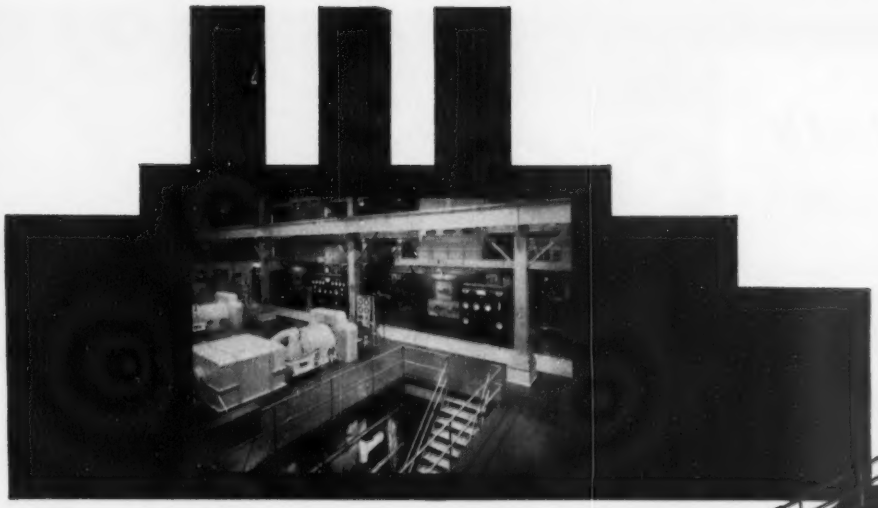
The Porcelain Insulator Corporation LIMA, N. Y.

Suspension Insulators . . . Clamps and Fittings . . . Switch and Bus Insulators . . . Distribution and High Voltage Pin Types . . . Guy and Tree Insulators . . . Special Porcelain.

E, I and Polyphase EI by Nomograph

W. KEGELMAN Engineering Development Section, Philadelphia Electric Co., Philadelphia, Pa.





MODERNIZE FOR EFFICIENCY

. . . INSIDE AND OUT!

When you modernize your power plant to increase output and efficiency, it's always evident that the cooling requirements of your new generating equipment should be served with equally modern facilities to achieve the most economical operation possible. That's why you see Pritchard cooling towers and air cooled heat exchangers performing vital cooling jobs in so many modern power installations.

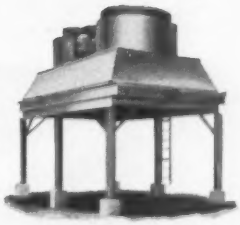
There are three good reasons why Pritchard cooling equipment does those jobs better: practical design, exclusive equipment features, quality construction. This all adds up to long, trouble-free, dependable cooling service. To get that for your installation, be sure you get Pritchard.

Industry's Partner for Progress

J. F. Pritchard Co.
OF CALIFORNIA
A DIVISION OF J. F. PRITCHARD & CO.
Dept. 383, 210 West 10th St., Kansas City 5, Mo.

COOLING TOWERS
AIR COOLED HEAT EXCHANGERS
GAS & AIR TREATING EQUIPMENT

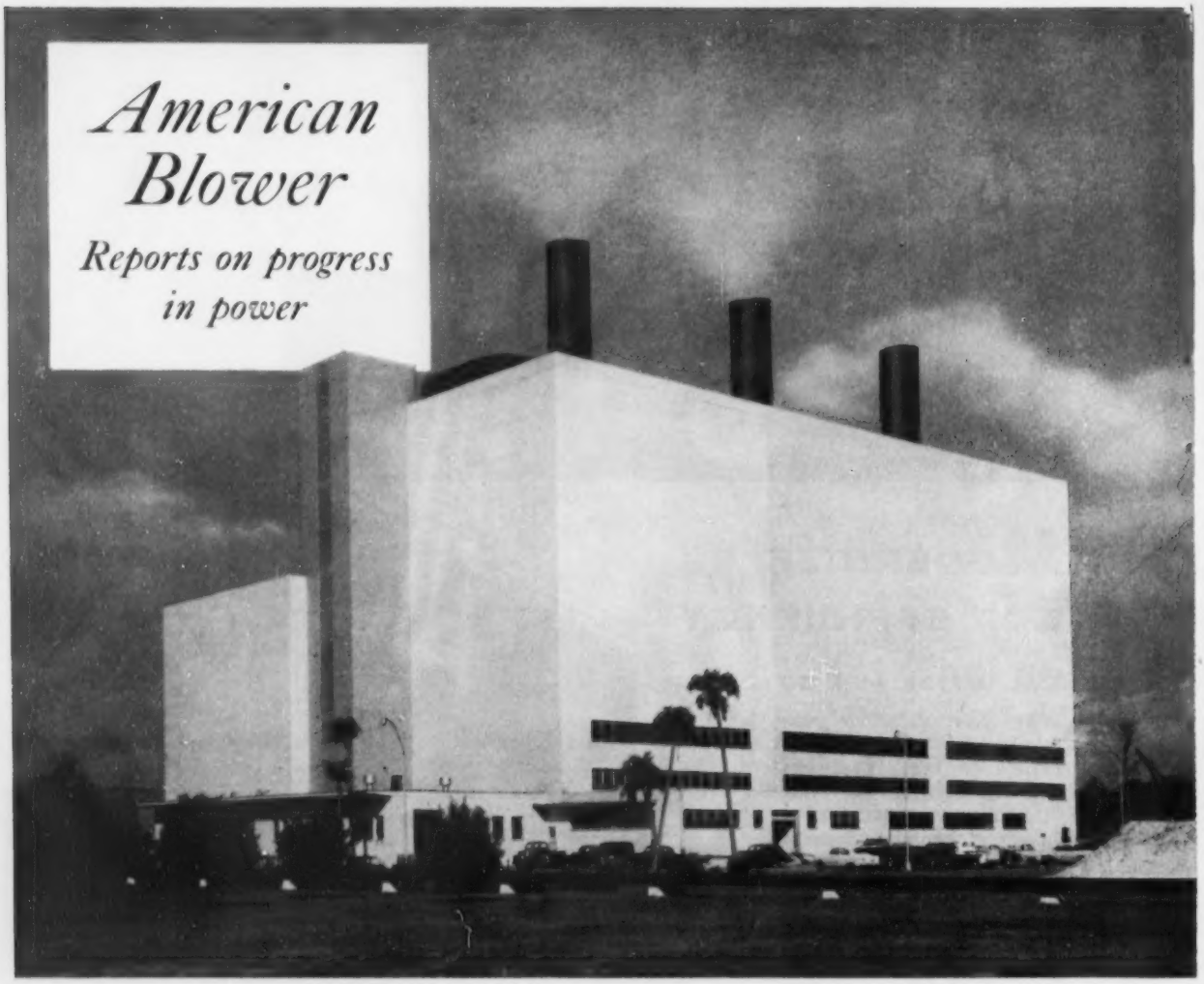
Representatives in Principal Cities from Coast to Coast



You'll obtain maximum heat transfer . . . with maximum savings . . . in jacket water cooling or other cooling operations with Pritchard QUINTAIR® air-cooled heat exchangers. In addition to the induced draft QUINTAIRS shown, forced draft units are available to meet specific operating requirements.

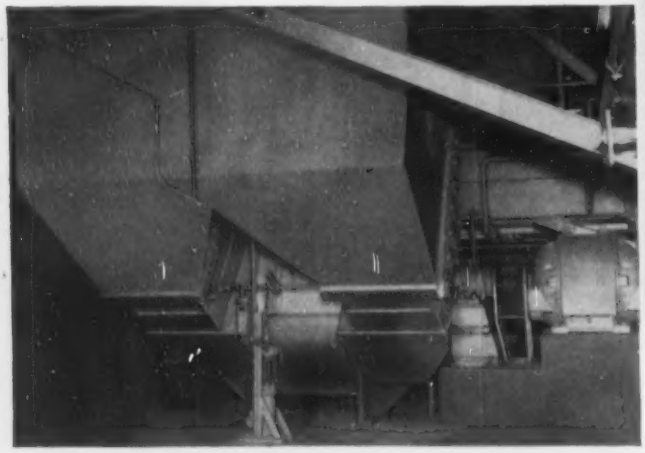
American Blower

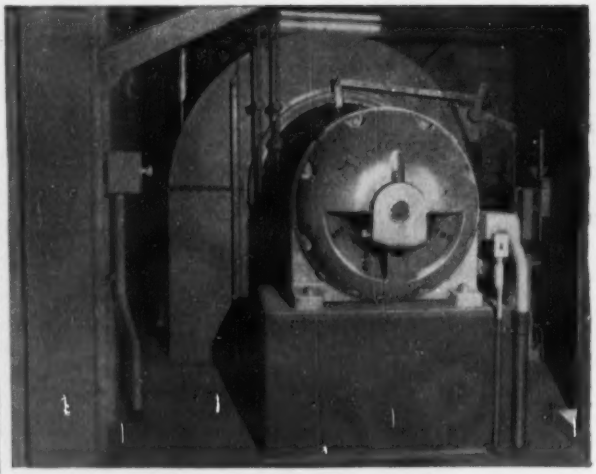
Reports on progress in power



Completed in 1954, the Higgins Plant at Oldsmar, Florida has a capability of 135,000 kw. Each of its three steam generating units requires 550,000 barrels of fuel oil annually.

Florida Power showed a remarkable increase (279%) in electric sales revenues from 1942 through 1952. Continued expansion is anticipated to meet the growing demand. Shown below is one of the new American Blower Induced Draft Fans on #1 boiler at the beautiful new Higgins Plant.



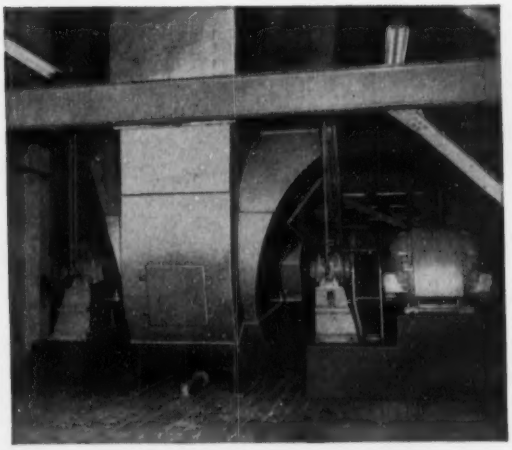


Also on Higgins #1 boiler is this American Blower Forced Draft Fan, rated at 81,400 cfm, 695 rpm, and 10.5" sp. Florida Power helps make the communities it serves good places to live and work.

Serving home and industry: **AMERICAN STANDARD** •

Florida Power Corporation keeps pace with rising needs for electricity

In 1897, the first plant of what is now the Florida Power Corporation went into operation with a wood-burning boiler and a 50 kw generator. Today, Florida Power and its subsidiary, Georgia Power and Light Company, serve 31 counties in Florida and 21 counties in Georgia. Total capacity is now 408,300 kw!



Here's another American Blower Sirocco Induced Draft Fan at the Higgins Plant. It is rated at 145,400 cfm, 695 rpm and 10.9" sp. Throughout the power plant industry, American Blower's experience and know-how are helping plant operators solve their power plant problems.

Naturally, this continued expansion has been based on the growing needs of the area for low-cost electricity for homes, business and industry. Future needs are anticipated and planned for . . . years ahead of time.

Like other investor-owned utilities, Florida Power keeps output high and costs low by selecting dependable, efficient equipment – including American Blower Forced and Induced Draft Fans.

Power plant operators everywhere are specifying American Blower Mechanical Draft Fans, Dust Collecting Equipment, Fly Ash Precipitators and Gyrol Fluid Drive for boiler feed pump and fan control. They know they can depend on American Blower Equipment and American Blower technical assistance.

If you have an air handling problem, or are planning to expand or modernize, find out how American Blower can help you. Contact your nearest American Blower Branch Office, or write us direct.

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONTARIO
Division of American Radiator & Standard Sanitary Corporation

AMERICAN BLOWER

AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

New Aluminum Alloy Developed for Bus Conductors

A new aluminum alloy for use as bus conductor has been developed by Reynolds Metals Co. Physical and electrical characteristics of the material are given in the accompanying table.

A primary aim of the development was to secure an aluminum-alloy bar having the same strength, in the direction of short-circuit forces, as a copper bar of the same current-carrying capacity. A tensile strength of 29,000 psi was selected as a minimum for the new alloy.

Some sacrifice of electrical conductivity resulted from adding alloying elements to the pure aluminum to obtain this desired tensile strength. Minimum value of conductivity was found to be 55% of the annealed copper standard. The manufacturer points out the fact that the current-carrying capacity for a given temperature rise is a function of the square root of the conductor's conductivity. In addition, the skin-effect resistance ratio, a function of conductivity, is said to be lower for the new metal than for comparable materials.

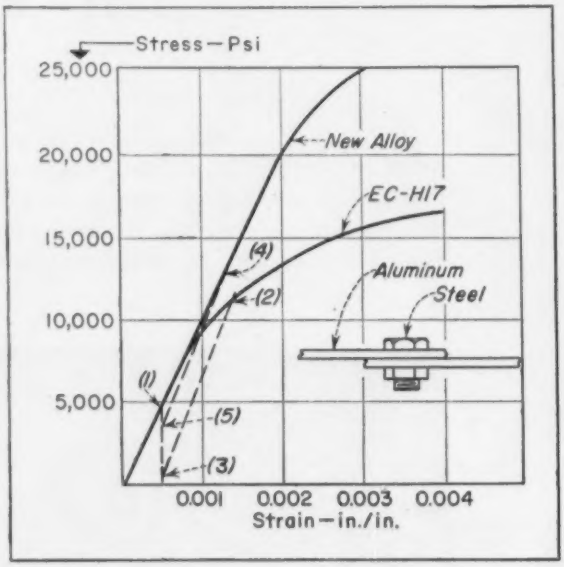
Temperature coefficient of resistance for the alloy is 0.360.

During heat cycling strength of the alloy is said to provide higher and more permanent stresses within joints fastened with steel bolts than does EC-H17 aluminum. Because of differences in coefficients of expansion of aluminum and steel, there is a relaxation of stress within the joint after heat cycling. The relaxation is less for the new alloy.

The accompanying, exaggerated stress-strain curve shows the effect of heat cycling on two lap joints fastened with steel bolts and stressed initially to the same value. As temperature increases stress in the EC aluminum joint increases from (1) to (2). Upon cooling the stress decreases to (3), which is considerably less than the original stress. When the bus joint of the new alloy is subjected to the same cycle, the loss in stress, from (1) to (5), is much less than that for EC aluminum.

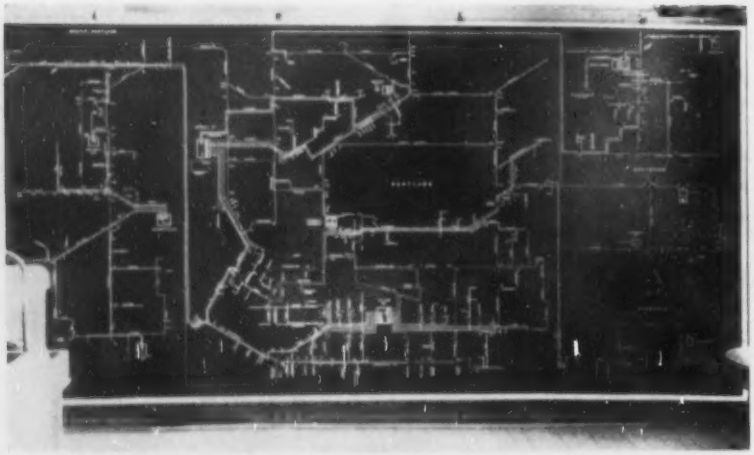
Properties of Copper and Aluminum Bus Conductor Materials

	Copper	Aluminum EC-H17	Aluminum New Alloy
Tensile Strength—Psi	33,000 to 37,500	17,000	29,000
Yield Strength—Psi	Not Specified	15,000	25,000
Electrical Conductivity—% IACS	98%	61%	55%
Current Carrying Capacity for Given Temperature Rise (Same Cross Section)	100%	82%	79%
Resistivity at 20 C—Microhms, Sq In./Ft.	9.31	13.36	14.82
Modulus of Elasticity—Lb/In.²	16×10^6	10×10^6	10×10^6
Density—Lb/In.³	0.322	0.09765	0.09765
Temp. Coeff. of Resistance—% per deg C at 20 C	0.393	0.403	0.360



STRESS-STRAIN CURVE for two aluminum buses shows that the loss in joint stress after heat cycling for the new alloy is rather small

Distribution Board Designed for Greater Flexibility



63 PRIMARY CIRCUITS are shown on this 13 x 6-ft board that is faced with black linoleum. Plastic tape, cribbage pegs, and colored golf tees are used for flexibility. Board was made in three sections and then bolted together to facilitate moving

Obsolescence of an old diagram board in the Portland Line Department of Central Maine Power Co led to a new design of increased scope and far greater flexibility. Engineered by John Elliott, the board shows 63 circuits in a 13 x 6-ft area—the wall space available in the line department.

The board is made of ¼-in. plywood glued to a 2 x 4-in. frame. Black inlaid linoleum is cemented to the face. To facilitate moving the board was made in three sections and bolted together.

All line and cable designations are made of ⅛-in. plastic tape in seven different colors. Corrections can be made easily. Open and closed cutouts are represented by red and green

(*Continued on page* 119)

Experience

···guides the expert

In the matter of choosing proper insulation, the experts are the men working the line—designing, building, and maintaining it. Prior experience with lines on similar terrain, under similar conditions, is the most valuable single guide in their selection of insulation for current and future line building. That's why O-B insulators are chosen—time after time; property after property—after a first order has demonstrated its strength in service. Men who know the demands that will be put on insulators, because of past experience, get the type they want from O-B—with confidence!

Thirty-three years ago this line was built and energized. It has remained in continuous service, with increasing load as its service area has grown. The insulation has met every need. There have been no failures. We feel that this is one reason why the power company continues a thirty-three year old habit—it buys O-B!

Ohio Brass

MANSFIELD OHIO, U. S. A.

IN CANADA: CANADIAN OHIO BRASS CO., LTD., NIAGARA FALLS, ONT.

two things to select in an insulator

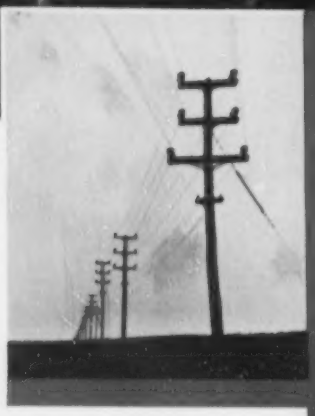
the *Right* type.... and the *Best* make

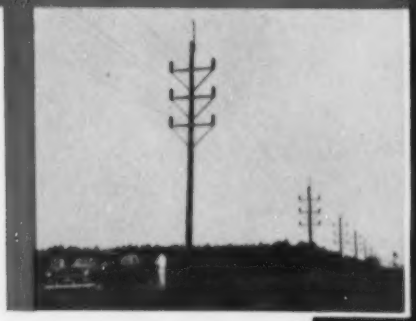
You can rely on O-B for both.

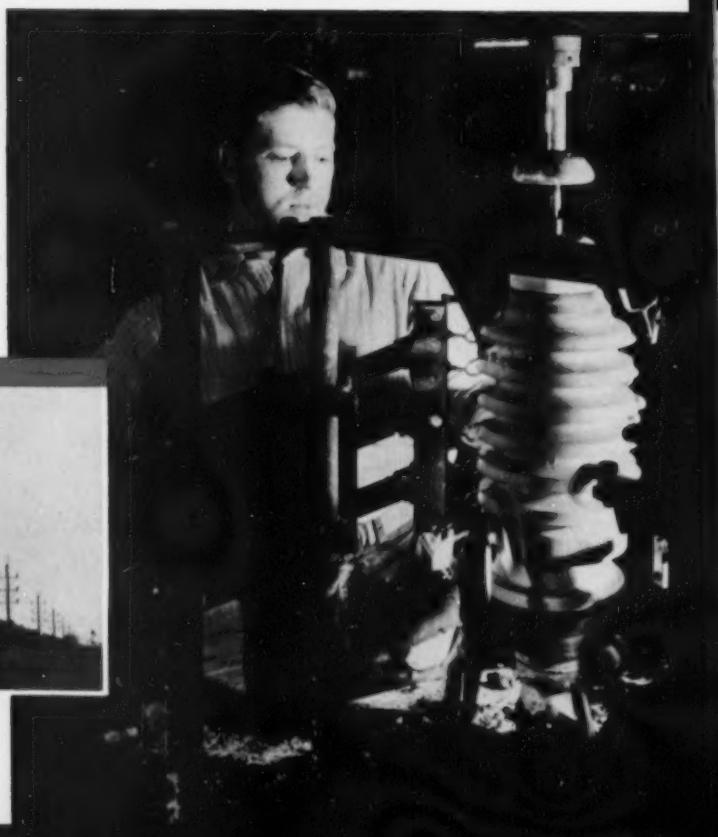
We make all types, and we make them in the best possible way. Each class—Pintype, Post, Suspension or Strain—gets the full and continuing attention of O-B research, design and manufacturing facilities. No weaklings, adopted for sales expediency, in the O-B insulator family. Whatever you get from O-B, you get the best—and the best we've got.

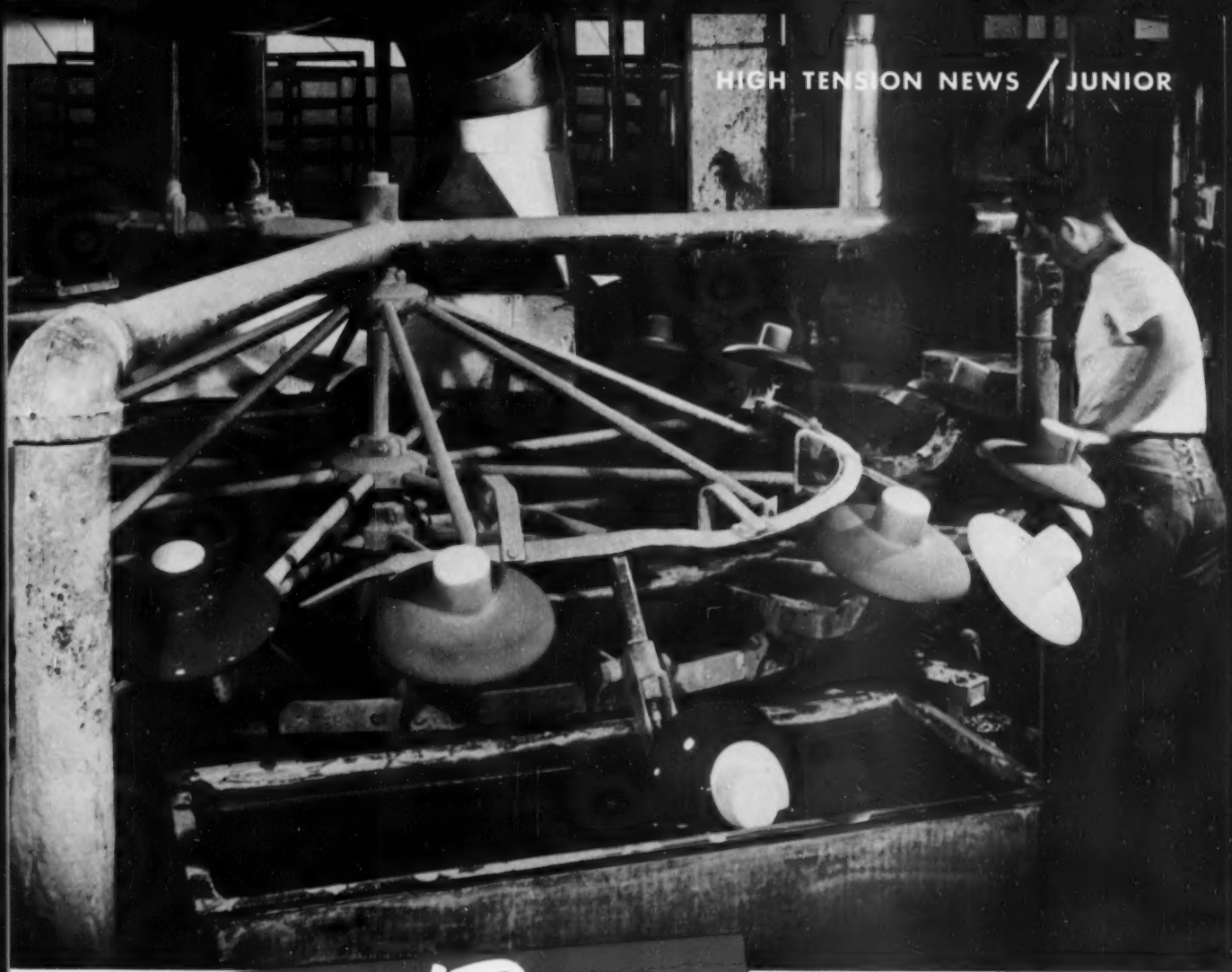
Choosing the right type depends on your knowledge of service conditions and previous experience in the performance of power lines. Getting the best make depends on your knowledge of the insulator manufacturer; on his ability to produce good insulation of all types.

And so, while the choice of *right* and *best* are both the line-builders' responsibility, there's a great amount of help to be had from Ohio Brass. You pick the type; it's our responsibility to *make* the best!









Improved Processes

improve the product

In making it our responsibility to make the best, Ohio Brass assumes an attitude of healthy skepticism toward established practice. Just because it's "been done that way for years" does not protect method from question; the fact is, old ways of doing things challenge, goad us toward making things faster, better, and of more value to the user.

An example: assembly line techniques applied to suspension insulator manufacture speed production, simplify quality control, and produce a more nearly uniform product. Such gains in processing as inconstant a raw material as clay advance the art of porcelain manufacture.

Such gains help us meet our responsibility to make the best!

INVEST IN SERVICE CONTINUITY WITH Ohio Brass INSULATORS

MANSFIELD OHIO, U. S. A.

You are within this circle!

Close cooperation between Ohio Brass Company and the Graybar organization keeps complete stocks of O-B Distribution Materials on hand at more than 100 Graybar warehouses all over the United States. Immediate action from the closest of these houses keeps you within the "overnight delivery" range (at the latest!)

Rely on O-B—Graybar to maintain a working stock of distribution materials for you. Talk it over with a Graybar man. He's worked out similar basic stock-on-hand requirements for other line builders, and he sees to it that they are maintained!

Ohio Brass

MANSFIELD OHIO, U. S. A.

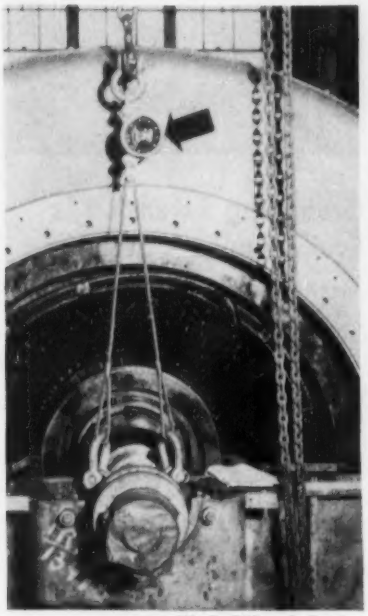
No. 4427-H

Distribution Board

(*Continued from page* 114)

cribbage pegs. Emergency or temporary switching is indicated by colored golf tees. Laterals and tie points are shown by the pegs. Pole numbers and streets are presented in ¼-in. white letters.

Primary feeder voltages on the diagram are 4.16, 11, and 12.47 kv. Because of space limitations only primary circuits in Portland and four suburban districts appear on the map. The 3-phase sections of these circuits, their tie points and line cutouts, are included.



W. C. Dillion & Co, Inc

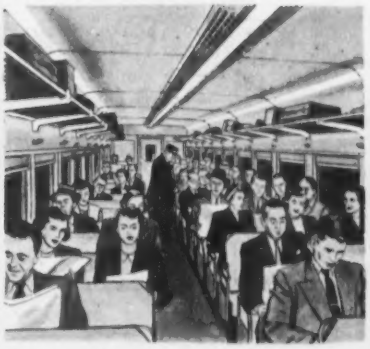
ALIGNING BEARINGS on 10,000-kw generator with a dynamometer saves time. Dynamometer indicates load on bearing

Dynamometer Saves Time Aligning Bearings

A method of aligning generator bearings with a dynamometer that saves considerable time has been developed by General Electric Co. On a three-bearing unit, the shaft of No. 3 bearing is supported by a crane, with a dynamometer between the crane hook and journal.

The journal is then positioned to carry the desired load. Similar checks on the other two bearings are unnecessary, because once the first bearing

HAS YOUR LIGHTING KEPT PACE WITH PROGRESS?



You're always ahead with Sylvania Fluorescent Lamps because of Engineering Exactness

The cathode coils inside Sylvania Fluorescent Lamps are precision wound . . . designed to hold an exact, predetermined amount of coating material. This is one of the tremendous trifles which accounts for the longer life and better performance of today's Sylvania lamps.

It's also one of the important reasons why Sylvania lamps can now offer you complete assurance of all-around satisfaction . . . or your money back.*

LIGHT FOR FREEDOM POWER FOR PROGRESS

* Try 24 Sylvania Fluorescent Lamps of any popular type. If, in your opinion they don't give more light and maintain color and brightness for a longer time than any other brand, send them back with your signed Certificate of Assurance and your money will be refunded.

SYLVANIA

Sylvania Electric Products Inc., 1740 Broadway, New York 19, N. Y.

In Canada: Sylvania Electric (Canada) Ltd., University Tower Bldg., St. Catherine St., Montreal, P. Q.

LIGHTING • RADIO • ELECTRONICS • TELEVISION

Direct, accurate measurements of signal components—15 to 500 kc

Model 121 Wave Analyzer

This new Sierra Wave Analyzer is designed to give you maximum operating ease, high accuracy and broad applicability in analyzing complex wave forms between 15 and 500 kc. The instrument is particularly useful for carrier system frequency analysis and induction studies, for determining filter transmission characteristics, or for measuring distortion and intermodulation components of rf signal sources and transmitters.

The Model 121 makes possible direct measurement of signal components throughout its range, and eliminates complex expensive setups with conventional receivers and signal generators. Input level range is + 42 to — 70 dbm at 600 ohms impedance. Measuring accuracy is ± 2 db; selectivity is such that response is 45 db down at 1 kc off resonance. Input bridging impedance is 10,000 ohms in the pass band.

Model 122 LINE-BRIDGING TRANSFORMER

The Sierra 122 Line-Bridging Transformer instantly converts Model 121 Wave Analyzer from single-ended to balanced input. The transformer is a broad band ferrite core unit operating flat within 0.5 db. from 15 to 500 kc. It is compensated so that Analyzer readings are corrected for the transformer's small insertion loss. Offered in three impedances: Model 122A, 135 ohms; 122B, 500 ohms; 122C, 600 ohms.

For complete information see your local Sierra sales representative or request Bulletin 103A

sierra

Sierra Electronic Corporation

San Carlos 2, California, U.S.A.

Sales representatives in major cities

Manufacturers of Carrier Frequency Voltmeters, Wave Analyzers, Line Fault Analyzers, Directional Couplers, Wide-Band RF Transformers, Custom Radio Transmitters.

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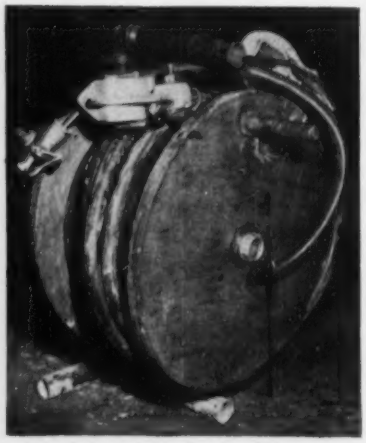
2789

has been properly set the other two will carry their calculated loads.

This method saves time over the former method of lining up three bearings by measuring down from a tight line that is stretched over the top of the generator.



Grounding Extension Is Easily Applied, Stored

WILLARD R. HECHT, Substation Dept, Indiana & Michigan Electric Co, Fort Wayne, Ind.

The cable reel and stand illustrated was constructed specially for adequately grounding equipment before it is worked on. Several advantages of the unit are:

1. Easy to store, handle, or apply. For example, one man can handle it without difficulty. A standard "trombone" hot stick is used to apply grounding clamps.

2. Eliminates tangled or twisted cables often caused by hand coiling.

3. Permits 60-ft extension of grounding cable simply by reeling off desired length before making connections.

4. Saves time because grounding clamps do not have to be bolted onto grounding cable and taken off each time they are used.

5. Economical to make.

The 20-in. diam, 8½-in. wide reel has ¾-in. weatherproof plywood ends, a wooden hub, and a 1-in. axle welded to the 3-footed pipe stand. The stand's upper horizontal projection prevents unwrapping of the reeled cable ends. Extending through the hub and turning on the axle is a 1¼-in. conduit having a lock washer and bushing on each end, which reinforce the reel. A

REMEMBER THIS

Our long experience in working with both utilities and the public is your assurance of dependable work and good customer relations.

YOUR BARTLETT DENDRICIAN...

A local man with a national reputation

When you employ Bartlett to take care of your trees, you not only get the benefit of the reputation and knowledge of a large national organization—you get the benefit of the services of local men familiar with local conditions.

In our research Laboratories at Stamford, a group of scientists are working constantly to find better ways to protect and preserve the shade trees of America.

But the man who actually does your tree work, the man who carries out the recommendations of our Laboratories is the Dendrician. He is a trained technician, similar in his way to the professional nurse. He knows the peculiarities of his patients and is skilled in the handling of the latest remedies and specialized equipment to restore them to health.

To qualify, the Bartlett Dendrician has to meet high physical and education requirements. He is then given comprehensive training at the Bartlett School of Tree Surgery. So, when he is assigned to a local office, he has not only had a skilful training in the fine art of tree care, he has been trained so that he can be depended upon to carry out the recommendations of your Bartlett representative and put into practice the knowledge of the Bartlett Tree Research Laboratories which stand behind them.

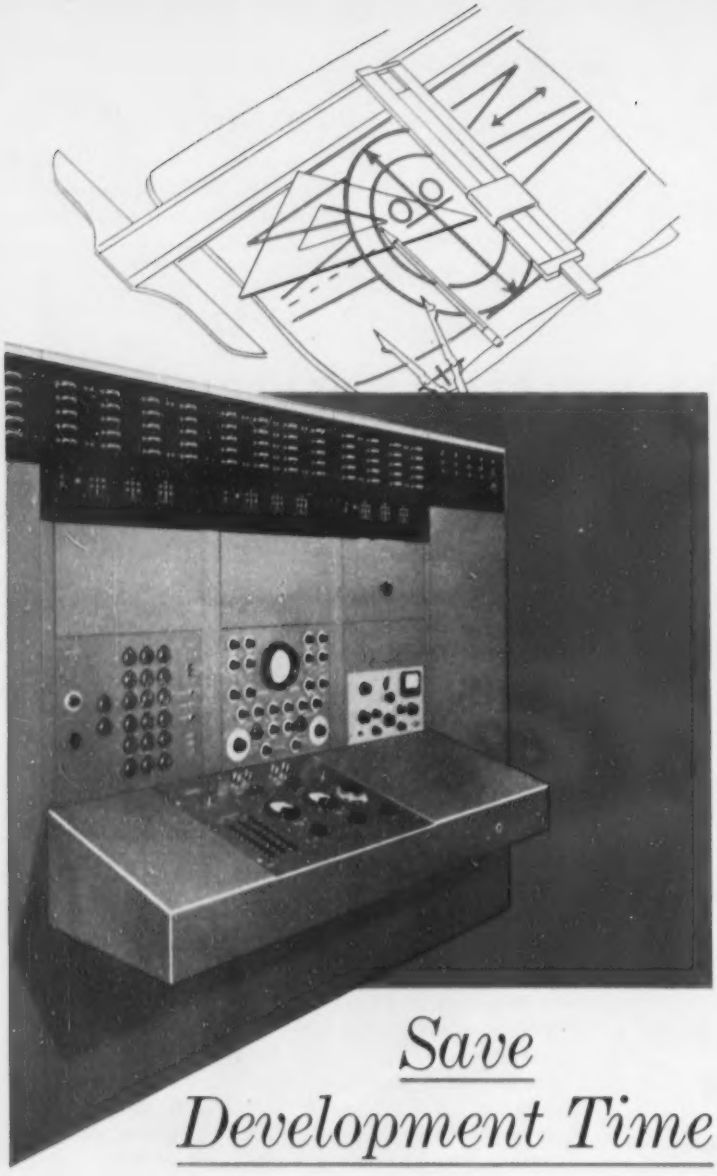
This teamwork—the combination of local Dendricians and the men in the Bartlett Tree Research Laboratories—has proved to those critical of results that the Bartlett Way (The Scientific Way) gives the best results in the long run. Call your nearest Bartlett office for a study of your tree situation.

The Bartlett Way

BARTLETT TREE EXPERTS

Home Office, Research Laboratory and Experimental Grounds, Stamford, Conn.

Local Offices from Maine to the Carolinas, and West to Indiana. See your Local Telephone Directory for Local Address.



Save Development Time...

REDUCE COSTS

Evaluation of design without actual construction of preliminary models is today an engineering necessity. The MILAC Analog Computer makes this short-cut possible by rapid solution of mathematical-electronic models of new systems or structures. Different approaches and solutions may be tried out more freely, for the cost of construction and test of prototypes for each design change is eliminated. Development costs and engineering man-hours are thus vastly reduced, for the MILAC accurately predicts and rules out faulty designs before final performance tests.

To demonstrate the usefulness of the MILAC Computer in engineering design and analysis, Wm. Miller Instruments maintains an Analog Computing Service, available for solution of either a single design problem or an overall development program.

Detailed information about either the MILAC Computer or the Analog Computing Service will be sent on request.

WM PASADENA

WM MILLER INSTRUMENTS, INC.

CUSTOM INSTRUMENT DESIGNERS AND MANUFACTURERS

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handle on the reel aids reeling in the cable.

Coiled on the reel is 60 ft of flexible No. 2/0, 600-v, rubber-covered cable. The inner cable end extends out of a hole near the hub and is attached to a grounding clamp. Outer end of the cable has three branches terminating in hotline clamps suitable for attachment to a wide range of connections—No. 2 to 1½ in. tubing. While unreeling or winding the cable, the clamp on the inner end can be attached to the reel handle to prevent twisting and excessive abrasion of the cable. The cable is similar to that used on grounding sets for line crews.

Steel Plates Cover Street Openings

G. V. SEAMONS,
Underground Dept, Oklahoma Gas & Electric Co, Oklahoma City

When doing underground work in the downtown district, Oklahoma Gas & Electric Co uses steel crossover plates to cover street openings and facilitate the movement of traffic. This also permits keeping the trench open long enough so that the concrete envelope around the duct lines can be poured all at once, after the duct run is completed.

Two different sizes of crossover plates are used, one for average traffic zones and the other for heavy traffic zones. Smaller size plates are constructed of ⅜-in. boiler plate steel, 3½ ft wide and 10 ft long, and weigh approximately 500 lb. They are used in the average traffic zones and are usually installed by hand.

Larger plates are constructed of ½-in. boiler plate steel, 3½ ft wide and 10 ft long. They weigh approximately 700 lb, and are usually installed with a light gin pole. However, they can also be installed by hand if necessary.

In most traffic zones the smaller size crossover plate is sufficient if the traffic is across and not with the excavation.

In order to prevent traffic from skidding the crossover plates from over the excavation, two 4 by 4-in. wooden pieces, 20 in. long, are bolted to the under side of the crossover plate. The pieces protrude down into the excavation and hold the crossover plate in place.

The pole that need not be climbed

Fastening wires with new tool.

Since telephony began, there has been just one way to install telephone wires on poles: have a trained man climb up and fasten them there. Now Bell Laboratories engineers have developed a special pole line for rural areas. The entire line can be erected without climbing a pole.

The whole job is done from the ground. Light-weight poles are quickly and easily erected. Newly created tools enable men to fasten wires to crossarms 10 to 25 feet over their heads.

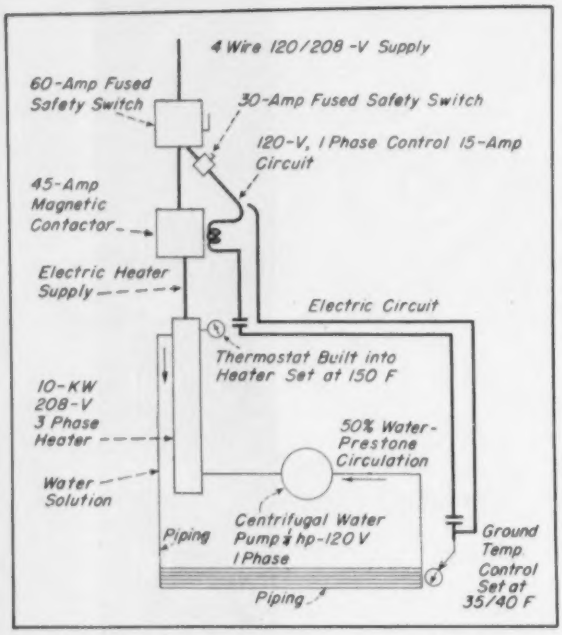
This inexpensive line promises more service in sparsely populated places. From original design to testing, it exemplifies a Bell Telephone Laboratories team operation in widening telephone service and keeping costs down.

Key to the new "climbless" pole is this insulator. Ground crews use long-handled tools to place the wire in position and then lock it fast.

Bell Telephone Laboratories

IMPROVING TELEPHONE SERVICE FOR AMERICA PROVIDES CAREERS FOR CREATIVE MEN IN SCIENTIFIC AND TECHNICAL FIELDS

ELECTRIC WATER HEATER and piping connections for one of the four units serving hangar door groups. Note temperature control in floor


4 Wire 120/208 -V Supply
60-Amp Fused Safety Switch
30-Amp Fused Safety Switch
120-V, 1 Phase Control 15-Amp Circuit
45-Amp Magnetic Contactor
Electric Heater Supply
Electric Circuit
Thermostat Built into Heater Set at 150 F
10-KW 208-V 3 Phase Heater
50% Water-Prestone Circulation
Water Solution
Piping
Centrifugal Water Pump ¼ hp-120 V 1 Phase
Ground Temp. Control Set at 35/40 F
Piping

WIRING DIAGRAM of control and supply system for one unit of heating equipment serving one set of rolling doors

Electric Heat Keeps Hangar Doors Operative

M. E. GOODRIDGE Worcester County Electric Co, Worcester, Mass.

The installation of electric water heaters in a new airplane storage hangar at the Municipal Airport, Worcester, Mass., has prevented the accumulation of snow and ice on the door rails and kept the doors operative all last winter. The electric units were installed at a considerable saving over oil burners and eliminated the potential fire hazard from oil storage and use. During the heating season from December to March 1954, the heaters and circulating pumps used less than 10,000 kwhr, costing about $190.00. The airport engineer is well satisfied with the installation and its moderate operating cost.

RAIL RUNWAYS for one section of hangar door freed from ice and snow by electric heat

The recently constructed storage hangar has 120-ft doors at either end. The doors at each end are divided into ten sections 12 ft wide and are mounted on wheels. At each doorway five sections can be rolled from the center to the sides of the building to provide complete opening.

No space heating was planned for this hangar and any heating installation had to be self-protecting. The wide separation of application points indicated the use of four separate heating units. Electrical equipment seemed the perfect fit. A study of heat requirements included the possible use of oil burner units, which called for an estimated 40,000 Btu per hour for each of the four sections of the hangar doorways. The Worcester County Electric Co proposed 10-kw electric heaters instead of oil heaters, or 40 kw to serve all four sets of doors, plus one centrifugal circulating pump for each set of doors. Each pump is driven by ¼-hp, 120-v, single-phase motor. These electric heaters each deliver 34,100 Btu per hour.

Each electric heater is provided with an expansion tank and the piping system for each of the four sections includes a nest of six pipes with header on each end. The pipes are installed under the rails at each end of the building. The piping system was filled with 50% "Prestone" solution, so that heat is required only when used for snow melting.

The water heaters operate on 208 v, 3-phase and have a nameplate rating of 12 kw at 230 v. The supply circuit is 3-phase, 4-wire, 120/208 v.

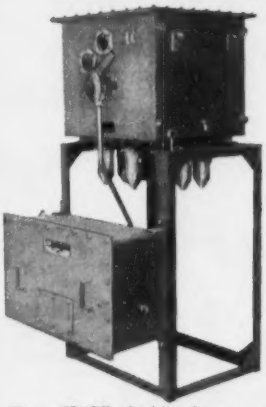
Use of the heating system requires manual closing of control circuits. This starts the circulating pumps and energizes the heaters through contactors. Each electric circulation heater has a thermostat for protection in case the water pump stops. An additional thermostat is located in the floor near rails to open heater contactor when ground exceeds 35 F.

The rate of water solution flow is such that the temperature pickup from the electric heater is about 10 F in passing through. With the ground control set at 35 F, the water temperature will probably never exceed 50 F.

(*More Industrials on page* 128)

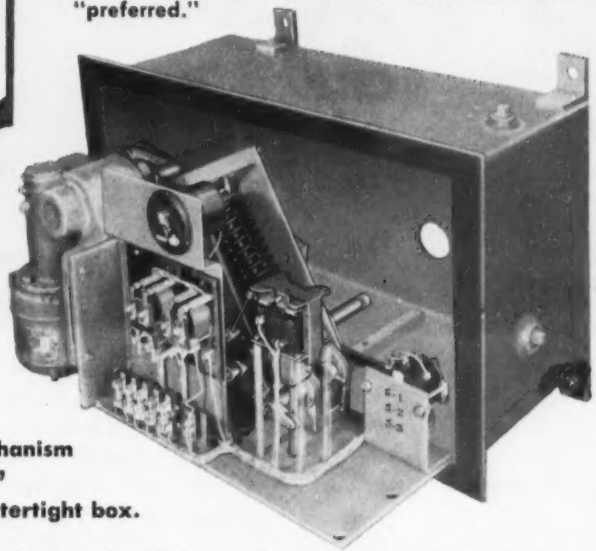
AVOID OUTAGES

by transferring important loads to an alternate feeder automatically



Type "RAD" double throw oil switch unit with Model "F" automatic mechanism.

- When preferred feeder voltage fails, the load is automatically transferred to the emergency feeder.
- When preferred feeder voltage is restored (for a period of ¾ minute) the load is automatically returned to the preferred feeder.
- There is no "hunting" on system disturbances. Load cannot be thrown to a "dead" source.
- Model "F6" automatic mechanism provides for remote operator selection of either feeder as the "preferred."



NEW
Improved mechanism
MODEL "F"
Enclosed in watertight box.

- Chassis is removable from simplified case • Motor uses intergral reduction gears
- Only one operating spring • Simplification results in lower price

The automatic mechanisms are applied to various forms of Type "RA" oil switches, either for underground cables or overhead connections—up to 23 Kv., 400 amperes. All control wiring is done at the factory. Installation of the unit merely involves connection of the feed and load cables or wires.

Send cable data and description of installation conditions for quotation on automatic transfer oil switches to meet your requirements.

G&W ELECTRIC SPECIALTY CO.
7780 Dante Avenue, Chicago 19, Illinois, U.S.A.
Representatives in principal cities of U.S.A.
In Canada—Powerlite Devices, Ltd., Toronto, Montreal & Vancouver

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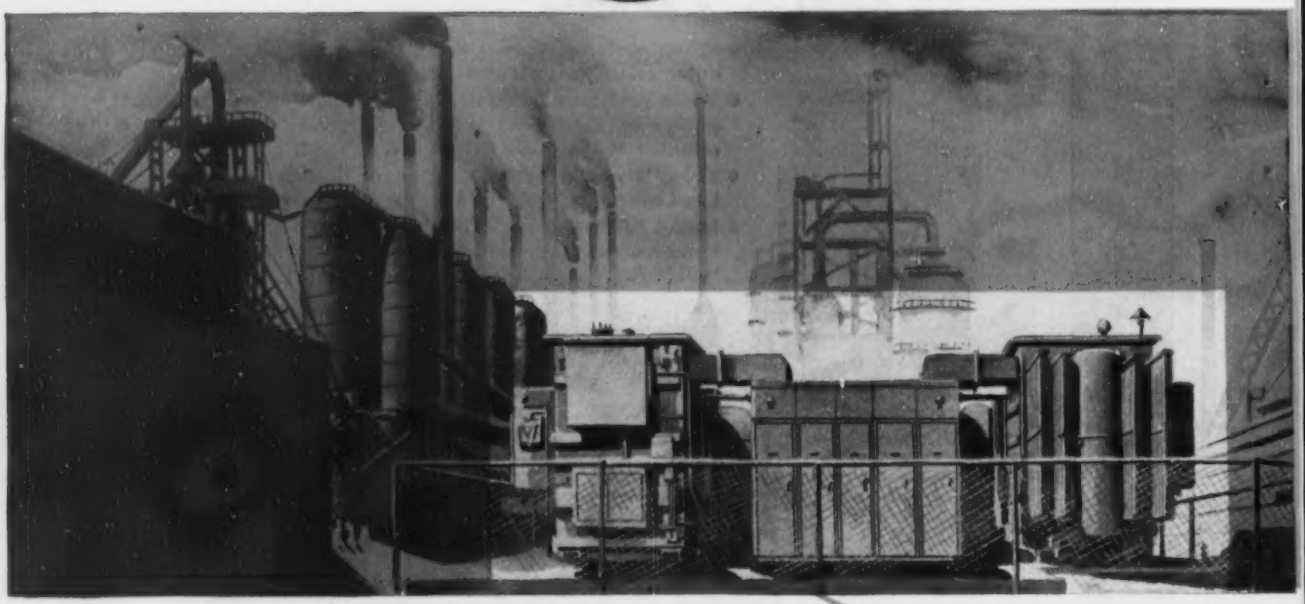
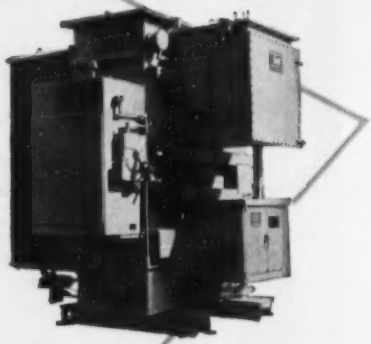
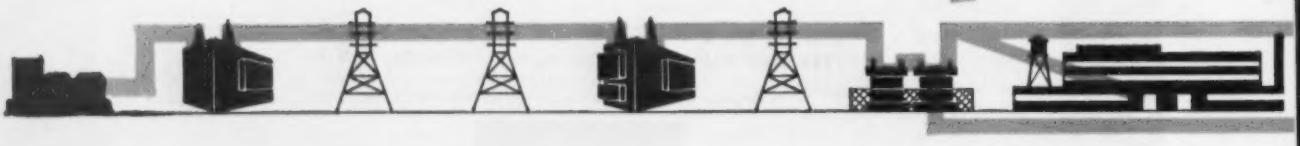
MOLONEY ELECTRIC

MOLONEY..





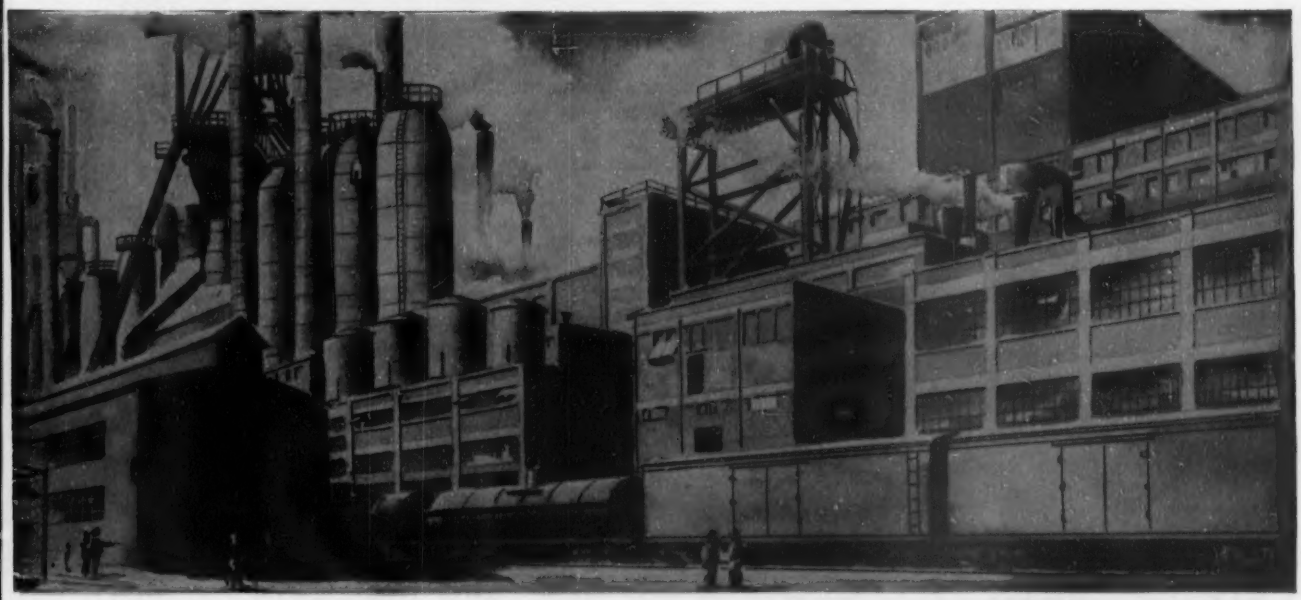
2500/3125 Kva Class OA/FA Load Ratio Control Transformers, three phase, 60 cycle, rated high voltage 34500 volts delta with disconnect switch, low voltage 5018 volts delta with plus or minus 10% regulation in 32 steps of ⅝%.



SALES OFFICES IN ALL PRINCIPAL CITIES • FACTORIES

For years the name Moloney on a transformer has meant a better product. As utilities have grown and become more complex, so have transformers. All this expansion in the power field has been paralleled by expansion here at Moloney. Many utilities feel that Moloney Transformers are the best you can buy. They are right, because—

. . A L L A L O N G T H E L I N E !



Take, for instance, Load Tap Changing Equipment; With dependable Moloney Automatic Load Tap Changing Equipment, a well regulated voltage system will result which offers advantages to both utility and consumer. The consumer advantage is trouble free functioning of equipment utilizing designed performance. The Utility advantage is utmost power delivery at times when power demands are profitable.

Moloney Load Tap Changing Equipment provides a positive power supply at a constant voltage. Only Moloney Load Tap Changing Equipment has the exclusive principle of reactor by-pass switching.

Available for Step Voltage Regulators, Regulating Transformers, Load Ratio Control Transformers, Phase Shifting Transformers or Special Applications.

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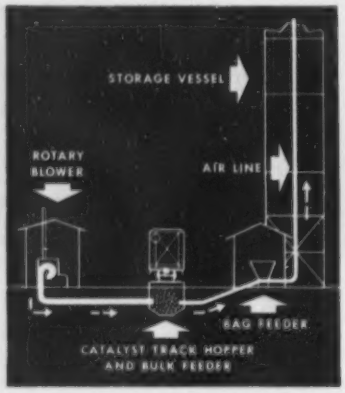
AT ST. LOUIS, MO. AND TORONTO, ONT., CANADA

what's NEW in Engineering

A new electronically-controlled manipulator has been developed by engineers at Argonne National Laboratory to permit scientists to handle "hot" radioactive materials at a distance of several hundred feet or from behind sealed barriers. The new unit, which uses electrical signals, reproduces the same seven basic motions involved in grasping, lifting, moving and turning objects.



Replacing a conventional mechanical batch system of handling catalyst, Kaiser Engineers developed a continuous air stream bulk handling method. Operating costs were reduced by this unique system which moves catalyst at 7½ tons per hour with an attrition loss of less than the 2% maximum guaranteed.

Modern Physics for the Engineer, edited by Louis N. Ridenour, is a collection of lectures given by a group of distinguished physicists and others at the University of California, Los Angeles. The aim of the book is to give engineers a brief account of some of the most interesting developments in this fundamental physical science. Published by McGraw-Hill.

Kaiser Engineers has approximately 600 professional engineers, technical experts and staff ready to tackle your problem in design, engineering or construction. Call or write: Kaiser Engineers Division of Henry J. Kaiser Company, Kaiser Building, Oakland 12, California.

Cure Cement Tile With Heat Lamps

NEPHI SACHS, Consultant,
Business Development Dept,
Utah Power & Light Co, Ogden

Infrared lamps are being used to cure cement roofing tile at the Holley Co, Ogden, Utah. Inexpensive to install or maintain, the lamps aid in curing the tile properly and at a very low unit cost.

Thin concrete slabs, such as tile shingles, have a fine sandy aggregate that requires more cement and more attention in curing. It is necessary to maintain an even temperature of about 90 F. This allows sweating about the tile so that moisture penetration is uniform.

At the Holley Co, 32 250-w infrared lamps are used to maintain a 90-F temperature in the drying room that measures 14x60 ft. An aluminum ceiling in the room is insulated with glass fiber which reflects light and is not affected by moisture.

The lamps may be switched in 25% steps to get the proper amount of heat. The initial curing period is from 12 to 24 hr depending on outside weather conditions. After that time outside air and moisture are sufficient for final curing. The tile then dries uniformly and evenly without cracks or chips. Total connected load includes two 8-kw drying rooms and 15 hp of motor load.

DRYING ROOM temperature is maintained at 90 F by 32 250-W infrared lamps

FLUORESCENT LAMP and luminaire maintenance is speeded by ladder racks

Ladder Racks Aid Lighting Maintenance

Aluminum ladder rigged with a holding rack for the luminaire and burned-out lamp, also the set of Micarta laminated plastic quivers for individual replacement lamps, lightens the lighting maintenance work at Westinghouse Transformer Division, Sharon, Pa.

Strip Heaters Aid Photostat Processing

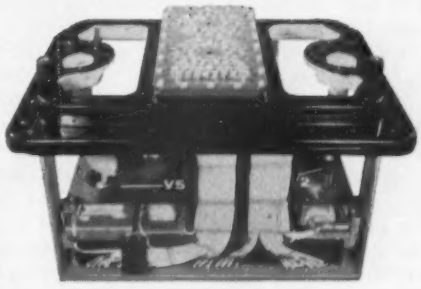
Heating developing solutions for photostats during cold weather with electric strip heaters at The Dayton Power and Light Co insures constant 72 F temperatures for turning out better photostats. Before the heaters were installed, the developing solution temperature varied over a wide range. The developing room is remote and receives no heat from the main building heating plant. A portable electric space heater keeps the operators warm in the winter but the solutions are cold. Two 250-w strip heaters are fastened to the bottom of the developer and fixer tanks. A thermostat is mounted to the bottom of these tanks to maintain constant temperature. Immersion heaters could not be used because the liquid depth in the trays is 2 in. or less. The thermostat bulb is not immersed because of the corrosive action of the solutions. Now the developing time is easily controlled and the solutions are not too cold for processing. Eldon W. Miller, Electric Heating Engineer, Dayton Power and Light Co.

NATVAR 400 in GERMANY

Few, if any, are the names in the electrical industry that are more *widely* known internationally than Siemens. Certainly none are more *favorably* known for the excellence of their products.

At the Siemens-Reiniger-Werke A. G. in Erlangen, Germany, construction materials are carefully tested and selected, particularly for such equipment as X-Ray apparatus which is expected to operate satisfactorily for many years with little or no maintenance. Natvar 400 Extruded Vinyl Tubing is used to insulate and protect leads of X-Ray transformers because of its uniformly good electrical and mechanical characteristics and its resistance to heat and oil.

If you need insulating materials with exceptionally good properties, you can depend on Natvar flexible insulations. They are available either from your wholesaler or direct, and are the same no matter when or where purchased.



Interior view of a 125 kv transformer used in X-Ray equipment manufactured by Siemens-Reiniger-Werke A. G. It is an oil immersed type and operates from a 380 volt AC power source. Primary leads are insulated and protected with Natvar 400 Extruded Vinyl Tubing which retains its excellent electrical and mechanical properties in spite of heat and oil.

Natvar

Natvar Products

- Varnished cambric—cloth and tape
- Varnished canvas and duck
- Varnished silk and special rayon
- Varnished—Silicone coated Fiberglas
- Varnished papers—rope and kraft
- Slot cell combinations, Aboglas®
- Vinyl coated—varnished—lacquered tubing and sleeving
- Extruded vinyl tubing and tape
- Styroflex® flexible polystyrene tape
- Extruded identification markers

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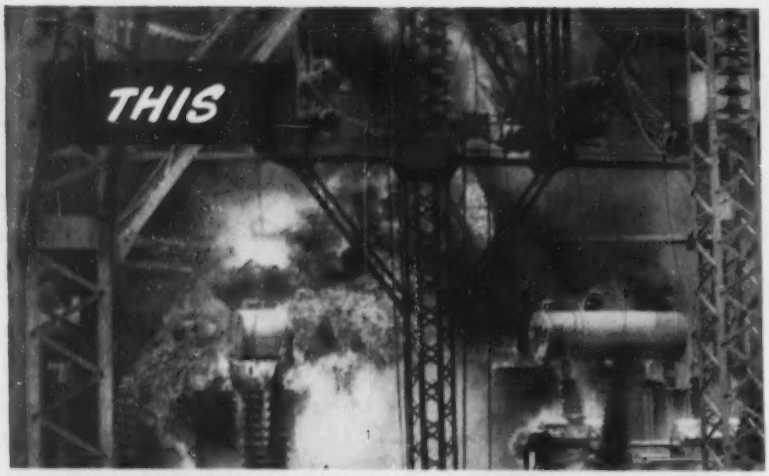
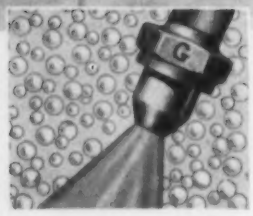




To protect your equipment, install safe, fast-acting

GRINNELL MULSIFYRE

All it ever takes, at any time, is for an arc to come in contact with oil to touch off a fire. If unchecked, as with the $50,000 blaze in the top picture, damage can be extensive.

But if there are spray projectors of a Grinnell Mulsifyre System on guard, such as those being demonstrated in the lower photograph, extinguishment usually can be obtained in a matter of seconds. In fact, the record is replete with cases of fires, occurring in oil, which fast-acting Grinnell Mulsifyre Systems have put out in quick time.

A Grinnell Mulsifyre Systems is effective wherever the danger of fire in medium or heavy oils can be limited to a definite area. In these oils the surface emulsion remains to give after-protection against flashback.

There are hundreds of dependable Mulsifyre installations in service all over the world. Get the facts on how you can save trouble and expense with a reliable Grinnell emulsion-forming spray system. Write Grinnell Company, Inc., 252 West Exchange Street, Providence, Rhode Island. Branch offices in principal cities.

GRINNELL *Mulsifyre*

EMULSION-EXTINGUISHMENT OF OIL FIRES

INDUSTRIAL BRIEFS

Melting steel in 1,200-kva, 1½-ton per hr electric melting furnace at the Crawford Steel Foundry, Bucyrus, Ohio, provides more flexibility and closer control of the analyses of various types of steel than was possible with the previously-used 20-ton open hearth melting furnace which company shut down. A more even production of castings is possible since the electric furnace can be relined over a weekend whereas the open hearth furnace required almost a month down time. Although furnace transformer is rated at 1,200 kva, the furnace is being operated at a rate of up to 1,650 kw without ill effect. V. C. Schumacher, Industrial Sales Representative, Ohio Power Co, Bucyrus, Ohio.

Brass brazing by new automatic brazing operation using a 90-kw electric salt bath brazing furnace at Monark Silver King, Inc, Chicago, Ill. saves 7 cents on each bicycle fork. The new system paid for itself after 4 months of operation. Production has been increased by 270%, from 75 to 280 forks per hour. Less than 1% show defects in joints, and even these can be salvaged by reworking. Previously the steel bicycle forks were brazed in two gas-fired pots containing molten brass. The operator preheated the forks by laying them on top of the furnace, and then dipping them into the molten brass, one fork at a time. Quality and production were naturally dependent on the alertness, speed, and efficiency of the operator. With this arrangement, two shifts of 8 hours each were required to produce 1200 forks. Rejects ran about 2% and it was not possible to rework them. Ajax Tips and Trends.

Baking paint on stainless steel furniture and soda fountain equipment with infrared heat has opened new markets for R. M. Green & Sons Inc, Nesquehoning, Pa at a low cost it didn't believe was possible. Company built the oven itself and installed 66 infrared units consisting of four 1000-w lamps per unit. Oven proved so successful Green hopes to expand production and add new employees. Clare Long, Industrial Power Representative, Pennsylvania Power & Light Co, Pottsville, Pa.

• Elkonite contacts offer designers of heavy-duty circuit interrupting equipment combined characteristics of:

Good electrical and thermal conductivity

Resistance to arc erosion

Resistance to sticking

Resistance to mechanical wear and impact

High hardness . . .

to a degree unequalled by other materials.

These qualities spell long, dependable contact life. They are achieved by the unique Elkonite process, developed by Mallory, which combines metals that will not alloy. New materials result, with physical properties often superior to those of their constituents.

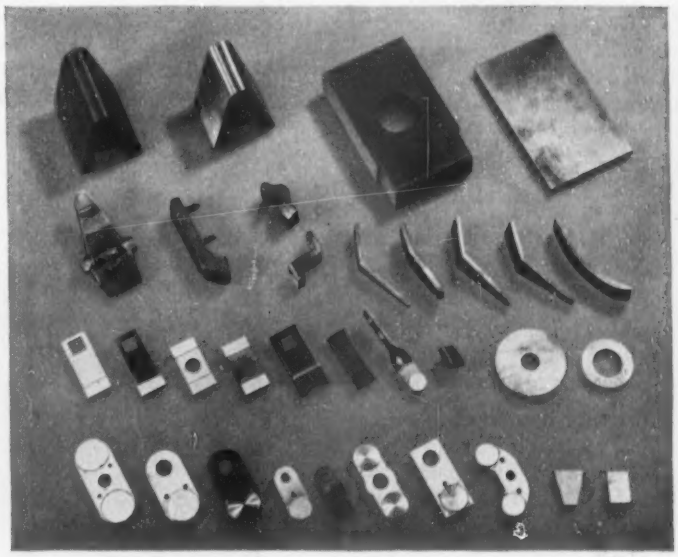
Thus, Elkonite combines the arc-resistance of refractory metals, such as tungsten, molybdenum or their carbides, with the high current-carrying ability of silver or copper. Elkonite contacts withstand severe short-circuit arcing conditions, and are the accepted standard for all heavy-duty circuit-interrupting equipment.

Only Elkonite offers *all* the characteristics you require for maximum performance in your product. An extensive selection of types is available to suit your specific requirements. For detailed technical information and valuable design data, write today for a copy of the new Mallory Contact Catalog.

For Heavy-Duty Service

ELKONITE® Contacts

Have No Equal



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P. R. MALLORY & CO. Inc.
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INFRARED LAMPS have found a new field of application in maternity ward of St. Bernard kennel on Russel Dice farm at Connersville, Ind.

PRIZE SHETLAND PONIES get off to a good start with the help of infrared lamps at Leon Clark's Kiddieland stables in Martinsville, Ind.

Infrared Lamps Brood Pups and Ponies

Problems of raising baby chicks and pigs have for several years been solved by using infrared (heat) lamp brooders. Public Service Co of Indiana reports the use of such lamps has been extended to the raising of puppies and ponies.

A St. Bernard kennel started use of infrared lamps when a litter of puppies arrived during a cool spell. A 250-w lamp was used to see the little pups through this crisis. They were so pleased with results, as shown by fine healthy pups and no losses, that now they depend on heat lamps to bring their litters along until the puppies are strong and well established.

Leon Clark of Martinsville, Ind. has found infrared lamps equally effective in colt brooding. Clark operates a Kiddieland, adjacent to a drive-in theater. Pony rides for children are a feature of Kiddieland.

When a colt was born during a cold snap, and was having trouble getting started, Clark, on advice of his Public Service Co of Indiana representative, installed a 250-w infrared lamp. Success has led to general use of lamps for the young colts.

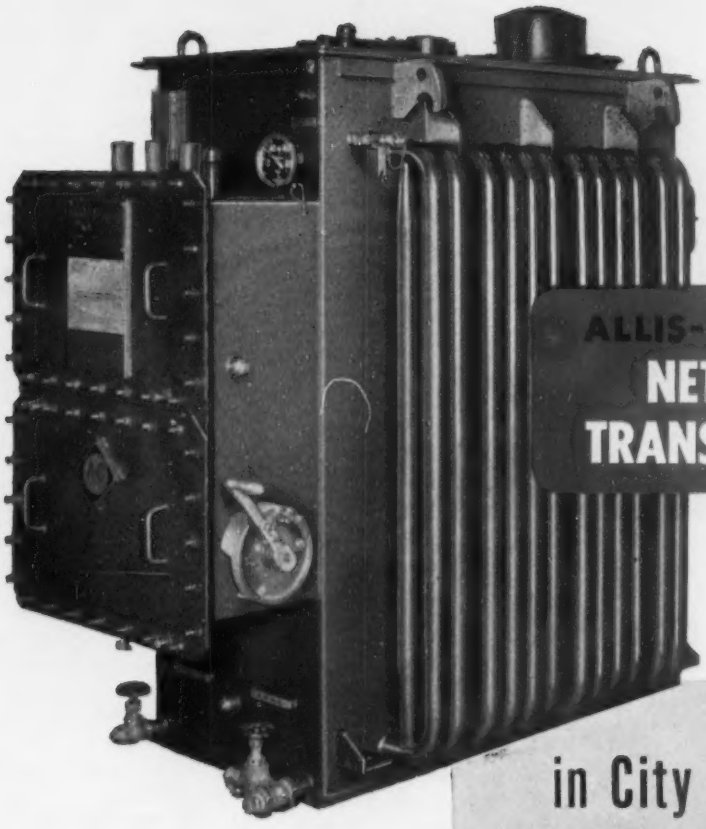
Wiring Financing:

Cincinnati rewires 592 homes, commercial jobs with its now famous credit plan . . .

Promotion of residential and commercial rewiring financing including use of display windows on Main Street at Cincinnati Gas & Electric Co offices (EW, Feb. 22, p 146 and June 28, p 87) has attracted considerable attention. The program started November 1, 1953. Through Aug 20, 1954, 592 jobs had been accepted from 200 contractors for a total amount of $143,622. Jobs run from $24 to $2,000 with an average of $251. Of the last 250 jobs, one-third were from contractors using this plan for the first time.

Cincinnati Gas and Electric Co recently offered the contractors an opportunity to participate in a direct mail campaign. A total of 56 contractors asked to be included. The utility imprinted the contractors' names on all their mailing pieces. The contractors, in turn, reimbursed the utility company for the special postage permit.

WINDOW DISPLAY at Cincinnati G&E's building tells folks they can rewire on easy credit terms. Working with contractors, utility also has used direct mail to promote plan



ALLIS-CHALMERS
NETWORK
TRANSFORMERS

Compact, low-loss design. Thermal capacities are high for severe load conditions. Sturdy, time-proven core and coil construction withstands repeated short-circuit stresses of network operation.

Safe, dependable tap-changing mechanism. Handle inserted through two-inch opening on cover operates mechanism. Handle cannot be removed unless it is in positive tap position. Cover location of handle entrance eliminates packing gland maintenance.

Threaded valve connections to tank are solder-wiped for extra protection. Valves are located for easy access. Globe-type valves with non-rotating seats close tight, avoid wear on valve seats.

Spiral-wound gaskets have proved their superiority over other types of gaskets for sealing bushings in the tank wall in over 6 years' continual use. Alternate plies of preformed springlike metal and non-metallic fillers provide unusual resilience and actually adjust themselves to changes in operating conditions. Gaskets can be installed without cements or grease. They can be quickly removed if required and may be re-used if necessary.

Shot blast cleaning, three coats of baked-on paint formulated for high water resistance, and compound treatment of base and tubes in base area give superior surface treatment. A-4317

in City after City...

PROVED

By Performance

On utility systems all over the country Allis-Chalmers network transformers meet the test of reliable and economical service. New A-C network units are ordered repeatedly to take their place alongside the more than 1¼ million kva already installed.

You get unusual flexibility in choice. To simplify your application problems, Allis-Chalmers builds all three basic types: oil-filled, *Chlorextol* liquid-filled, and sealed dry type.

It will pay you to investigate the design and construction details of Allis-Chalmers network transformers before you order your next unit. Consult the A-C district office near you or write Allis-Chalmers, Milwaukee 1, Wisconsin, for more information.

Chlorextol is an Allis-Chalmers trademark.

ALLIS-CHALMERS

BENEFITS of room air conditioning are effectively displayed in bank window. In addition to window and console units, display contains props like water, dirt bags to describe benefits

Bank Promotes Air Conditioning

Here is an idea for utility sales departments in enlisting aid in promoting load building equipment and appliances.

The First National Bank and Trust Co of Paterson, New Jersey, recently displayed air conditioning equipment so successfully that the usual 2-week period for displays was extended to 4 weeks. This precedent was broken because of the unusually large number of people that viewed the display.

The bank believes that by helping to sell products of local merchants they help sell their own services. They put their theory to work in the form of seasonal window displays with educational themes merchandising the respective consumer products, local retail outlets and the bank's finance service.

According to vice president Conrad Legare, this recent window created by Remington Air Conditioners of New Jersey, Inc, dramatically illustrated the benefits of year 'round air conditioning. The tie-up between this manufacturer and the bank was effected by a card listing its dealers and announcing that purchases of air conditioners could be financed through the bank.

In addition to window and console units, the display consisted of props which described benefits of air conditioning. Quart bottles of water dramatized control of humidity, and a card pointed out that "40 quarts of moisture can be removed from room air every 24 hours." A broom, dustpan and cellophane bag of dirt and soot illustrated an air conditioner's filtering efficiency. An accompanying card stated, "save 12 hours of cleaning time each week . . . Remington removes 98% of suspended dust, pollen and soot from the air."

Commercial Cooking Drive Ups Duquesne Revenues

ALEX R. HAMPSEY, JR,
Supervisor Training and Education
Duquesne Light Co, Pittsburgh, Pa

Sale of 729 pieces of new commercial electric cooking equipment estimated to add nearly $80,000 to its annual electric revenues is reported by Duquesne Light Co as the result of its sixth annual "All-Industry Coordinated Commercial Electric Cooking Activity".

The activity, which ran from Jan. 26 to April 25, 1954 was directed by Duquesne with active cooperation from major equipment manufacturers, distributors and dealers.

A sales quota of 3,000 kw was set, representing an annual revenue of approximately $63,000. When the actual results were tallied, 3,858.7 kw had been added, topping the quota by 28.5%. Some $77,924 in additional annual revenue was expected.

Blueprint for the highly successful program was composed of four separate but closely integrated fields of endeavor:

1. Utility sales personnel concentrated the bulk of their sales calls and efforts on food service customers.
2. Dealer and utility sales people were encouraged to place extra emphasis on commercial electric cooking by means of a cash incentive plan.
3. A series of direct mail pieces were sent out at regular intervals during activity's 12-week period.
4. An "All-Electric Center" exhibit was set up at the Pennsylvania State Restaurant Show in Pittsburgh Jan. 18-19-20.

Sales representatives concentrated 63% of their sales calls (a total of 4,167) on food service accounts; 5.7 calls were made for every sale; average number of kw per sale was 5.3. A total of 117 demonstrations were made including actual demonstrations of equipment and visitations by customers to other electric cooking installations. Duquesne found the visitations proved especially helpful in closing sales.

To help create enthusiasm and build competitive spirit, incentive plans for both company and dealer sales personnel were offered.

When the program was concluded, Duquesne found, thanks to efforts like this, that more than 34,000 kw of commercial electric cooking equipment had been added to its system since 1940.

S & S Shorts

New Campaigns: General Electric's 1954 "Bulbsnatcher Blitz" will get underway from coast to coast Oct. 1. Merchandising displays will feature colorful cop admonishing consumers to "STOP Bulbsnatching".

New Products: Less need for cleaning and higher efficiency are claimed for new school lighting fixture, announced by Gibson Manufacturing Co. Convection currents keep fixtures clean, cuts maintenance says maker. . . .

Smithcraft Lighting Division has new functional store lighting system, which may be arranged in multiple rows or end to end without requiring lampholders or conventional housings.

MARLOWE SUBSTATION—

"Packaged" for Potomac

. . . from penciled line diagram to completed substation—with one contact! That's the story of the building of Marlowe Substation.

Fast-growing Potomac Edison with headquarters at Hagerstown, Maryland, covers 8,000 square miles of rural, industrial and commercial load area. Their basic transmission triangle, with sides approximately 60 miles in length, has just been stepped up to 132 kv.

Marlowe, master control link in this new system, is a modern coordinated substation. The details of its construction, with some of the outstanding factors responsible for savings realized, are told on the next seven pages.

Grouped in front of the system dispatching board at Marlowe Substation of Potomac Edison Company are (left to right): C. S. James, System Operator; H. H. Startzman, Chief Engineer; W. C. Feaster, Electrical Engineer—all of Potomac Edison—and J. N. "Nick" King, local Westinghouse representative—Potomac's one contact.

Westinghouse

Over-all view of Marlowe Substation—operational headquarters of Potomac Edison's 8,000-square-mile system. A fully coordinated modern substation by Westinghouse.

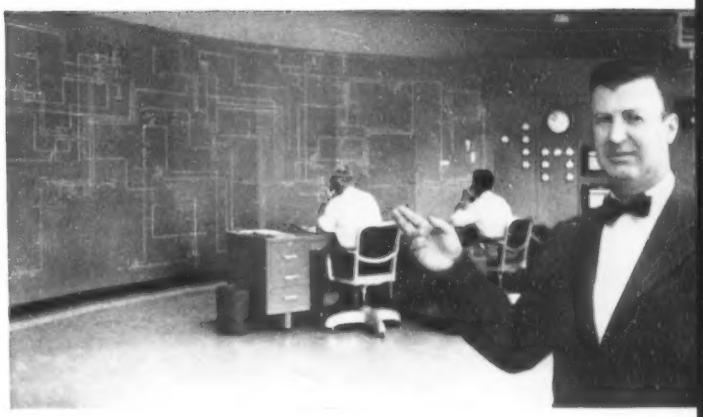
K. C. Miller, Construction Foreman for Potomac Edison, who was in charge of building Marlowe Substation. The complete packaged coordination of Marlowe made his job easier—and faster. Note space-saving underhung Type RL side break disconnects for circuit breaker isolation.

Modern Marlowe Substation is Potomac's operational nerve center

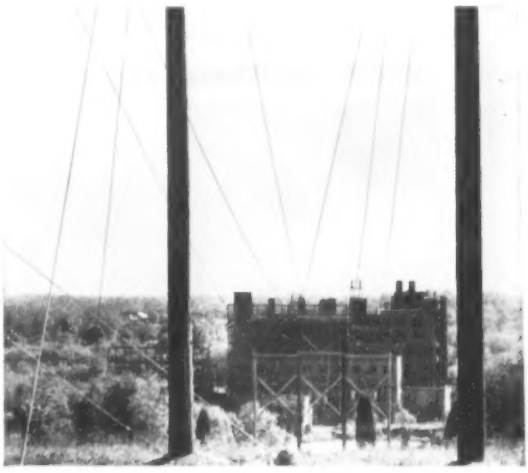
The site for Marlowe Substation—on the high south bank of the Potomac directly opposite the R. Paul Smith generating station—was selected for three reasons. First, it avoids the possibility of flood, which in 1936 completely submerged the first floor of Smith Station. Second, the high south bank enables Marlowe to avoid excessive maintenance costs due to smog and fly ash. And third, Marlowe is the load center of Potomac Edison's growing system.

From Marlowe, system load dispatchers supervise and control transmission of power to all points on company property—utilizing microwave and power line carrier for communication and protective relaying. The most modern of protective and control equipment makes Marlowe Potomac's most efficiently operated substation.

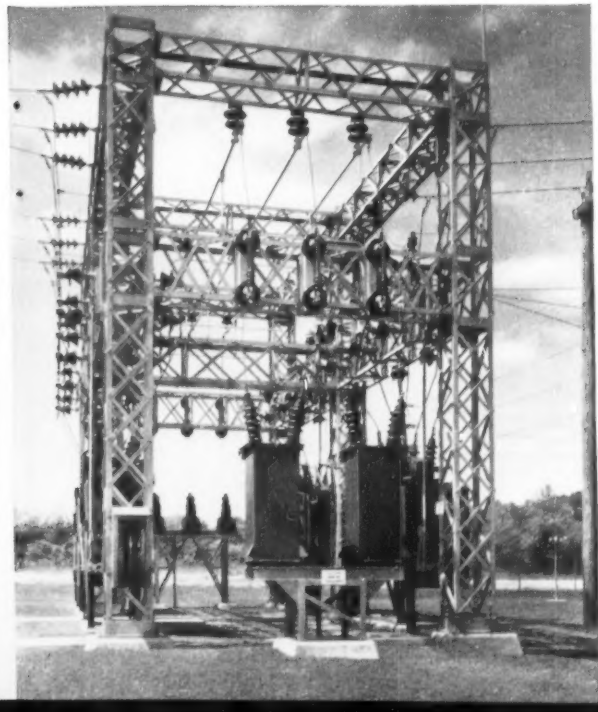
Let's see how Nick King and Westinghouse helped Potomac to beat their construction deadline and also, in the words of H. H. Startzman, Chief Engineer of Potomac Edison, made possible "substantial savings in engineering costs".



C. S. James and his system dispatchers at the large, color-coded dispatching board at Marlowe. From this point, dispatchers supervise and control transmission of power throughout the system.



View from Marlowe Substation down the hill and across the Potomac River to the R. Paul Smith Station—largest of Potomac's 15 generating stations; capacity 91,400 kw.

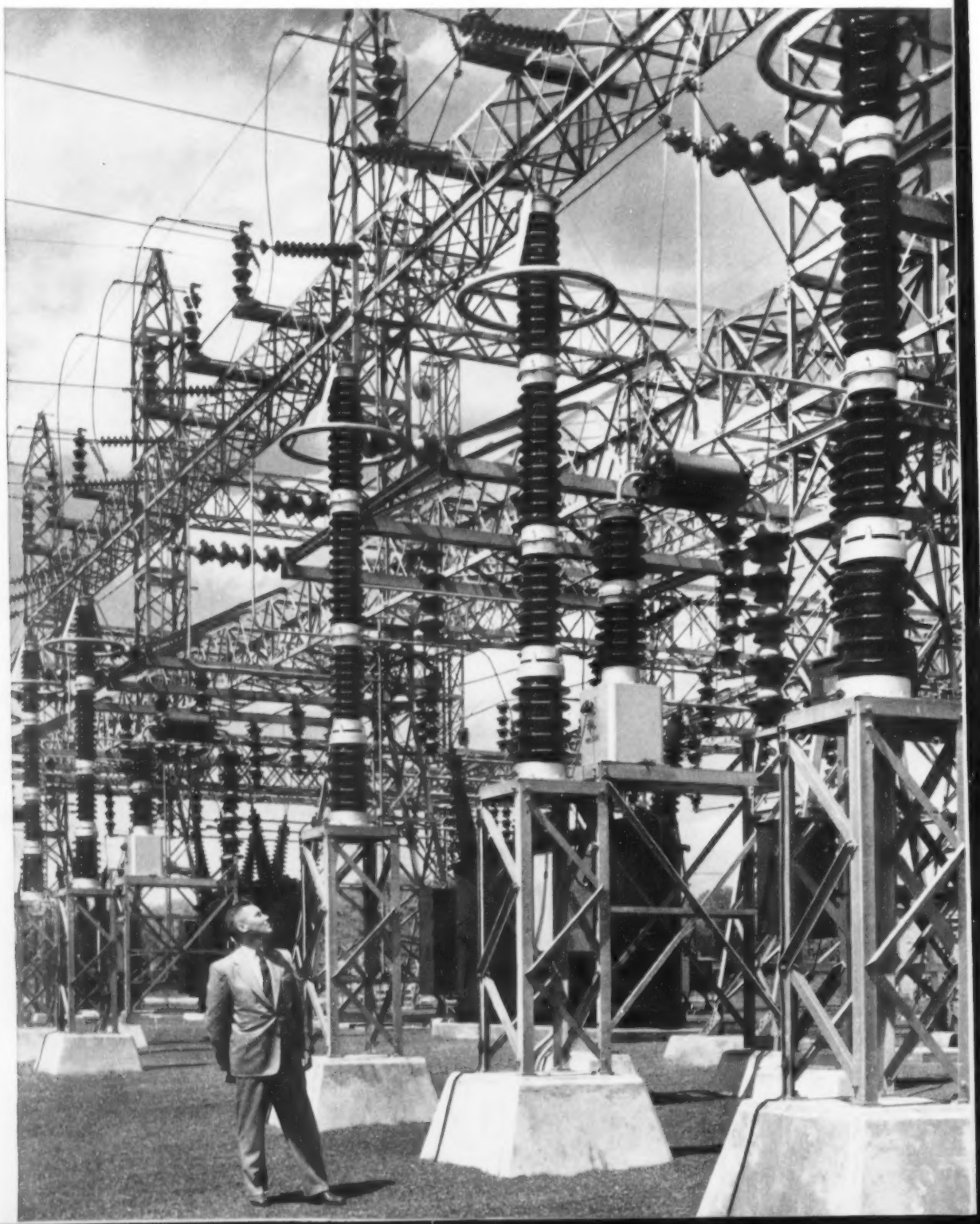


"Package within a package" is this 34.5-kv unit which supplies the area surrounding Marlowe Substation. Shown in the foreground are Westinghouse Type SL station service transformers protected by BA De-ion® power fuses.

YOU CAN BE SURE...IF IT'S Westinghouse

From penciled diagram to an "on-the-line" substation . . . with

"It went up so easily," said Doc Miller, Construction Foreman of Potomac Edison, "we thought there must be a catch to it. *There wasn't!*" The reasons why Marlowe Substation "went up easily" are good ones. From the time that W. C. Feaster handed Nick King a simple penciled diagram of basic requirements, the coordinated sequence of events occurred like this:



one source . . . Westinghouse

First, complete drawings arrived at Potomac which showed the general layout of Marlowe Substation. Details were included which permitted Doc Miller to begin building foundations. Loading calculations showing thrusts and mechanical stress data showed exactly how much concrete to use.

Equipment drawings then arrived to enable Doc to build pads and arrange for all connections including those underground.

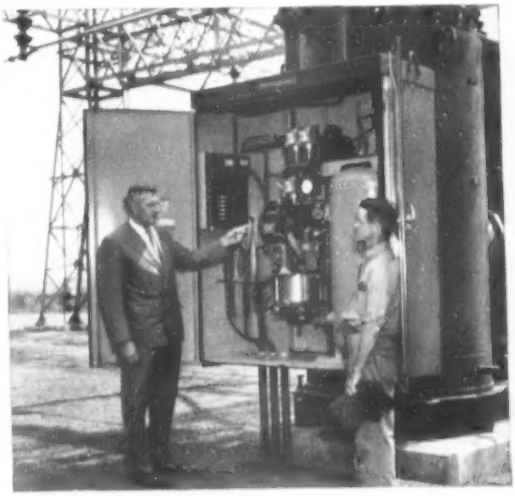
The complete station structure came in on schedule and Doc Miller and his crew erected it using detailed erection drawings which accompanied it.

Power circuit breakers were next on the scene so that they could be placed with the crane which had been used to erect the steel structure.

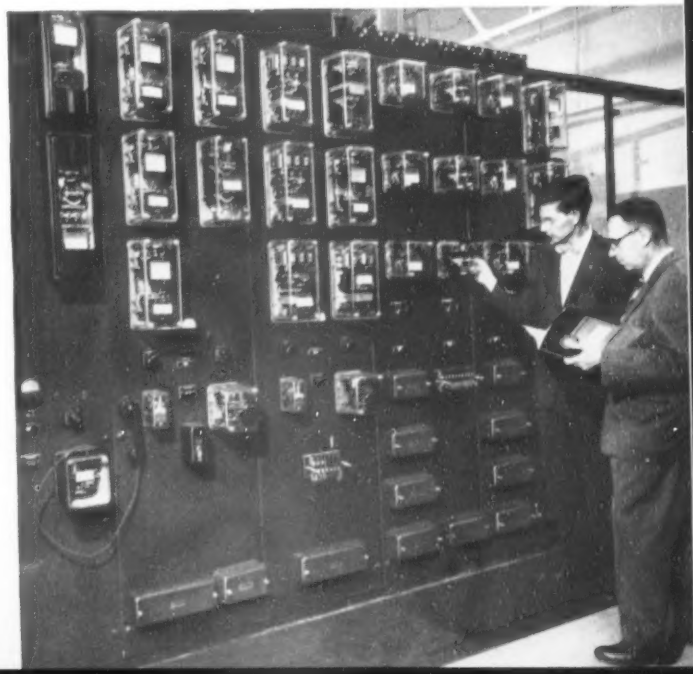
Final delivery of all remaining equipment including a 40,000-kva "Form-Fit" power transformer, lightning arresters, disconnecting switches, power fuses, instrument transformers, line traps and many other items was made when Doc was ready for them.

Marlowe Substation including communication and relaying apparatus was energized on July 30, 1953—well ahead of schedule.

H. B. Pitzer, Potomac Edison Communications Engineer, at a Westinghouse Type FB microwave radio assembly operating in the 952 to 960 megacycle band. Three repeater stations are used over 70 miles of mountainous terrain to Ridgeley Station at Cumberland, Maryland. Four voice channels, two telemetering, one VHF radio control and one test channel are in use at Marlowe.



W. C. Feaster describes operation of pneumatic mechanism of a Type GM-4-A, 138-kv class circuit breaker to E. E. "Ed" Hays, Substation Operator at Marlowe. The Type AA-10 pneumatic operating mechanism shown is capable of high-speed, 3-cycle opening and 20-cycle reclosing with minimum shock to parts.

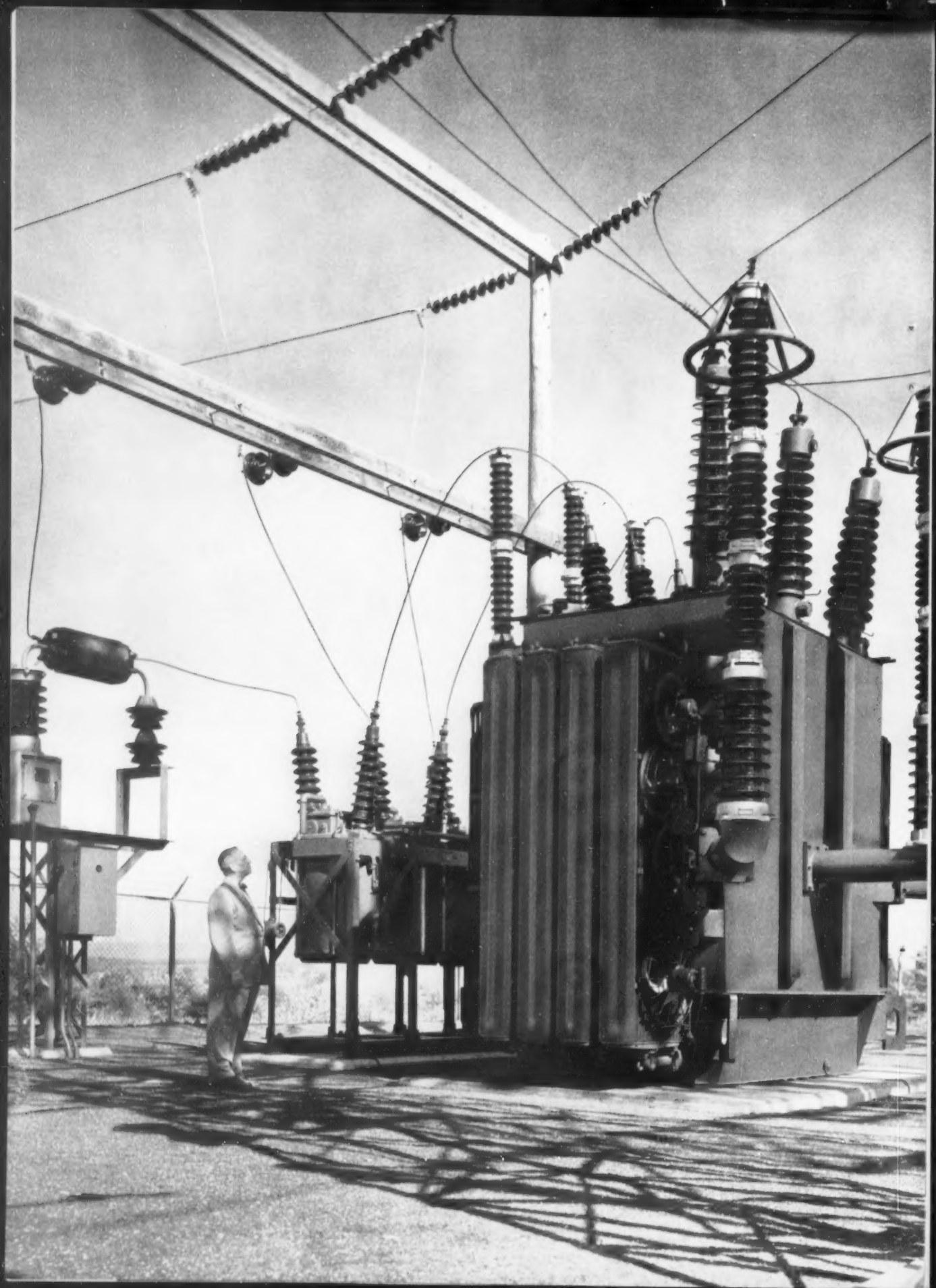


E. R. Cushen, Test Engineer, and Charles Morrison, Planning Engineer of Potomac Edison, at power line carrier relay panel. The first three sections of this panel include Types CR, HKB, HZM and HRP relays for protection of 132-kv lines. The last two panels include Types CA-5, LC-2 and CO relays for transformer and bus protection.

O. L. Wallis, Potomac Edison Assistant Electrical Engineer, inspects Marlowe Substation's Westinghouse station-type Autovalve® arresters which protect the 132-kv equipment. SV arresters will discharge lightning surges of more than 100,000 amperes. They are designed to give the greatest protective margins available in high-capacity arresters.

YOU CAN BE **SURE** . . . IF IT'S

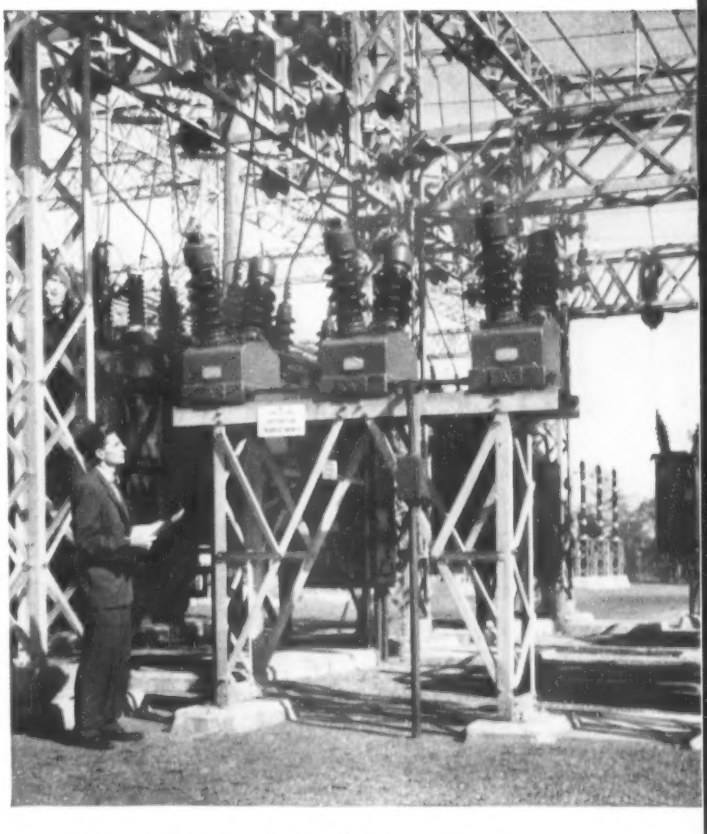
Westinghouse



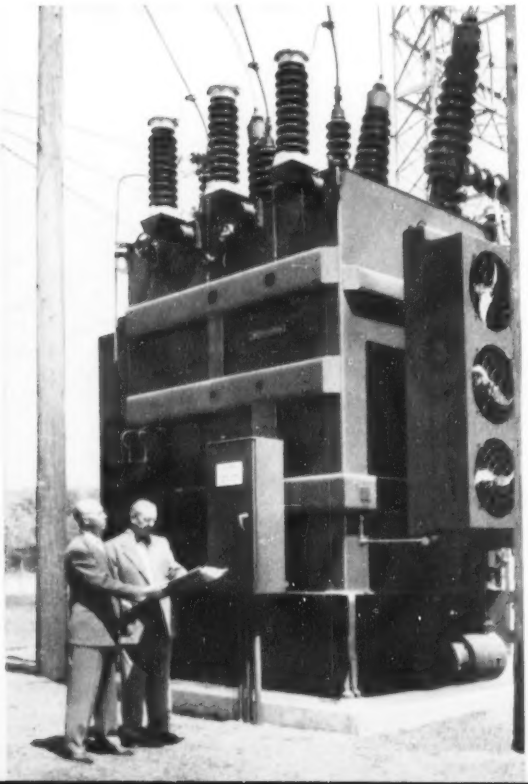
Standardized equipment for Marlowe meant faster delivery... simplified installation... lower costs

Standardized Westinghouse equipment was used throughout Marlowe Substation. It contributed greatly to savings in both time and money because it cut time in engineering, manufacturing, delivery and installation. Doc Miller's construction personnel had no "specials" to deal with.

In addition, the delivery of Marlowe Substation with one order—one supplier—one responsibility—proved conclusively to Potomac Edison executives that substantial savings could be realized while still maintaining rigid standards for reliability and flexibility for future growth. Each component of Marlowe is designed to permit future expansion with minimum changes or additions.



H. H. Startzman at the 69-kv/132-kv, OA/FA Form-Fit power transformer of Marlowe Substation. *Marlowe Substation is the third site for this transformer, since it has been moved with progress of Potomac's 132-kv expansion.* The lighter weight, smaller size and rugged construction of Form-Fit power transformers were distinct advantages to these moves. Note that the SV arresters are mounted on the transformer close to the bushings for maximum protection.



E. R. Cushen checking installation of three Westinghouse OPT, 34.5-kv potential transformers. Westinghouse instrument transformers are noted for reliability and accuracy.

J. N. King and H. H. Startzman, at the 132-kv/34.5-kv Form-Fit power transformer—second largest on Potomac's system. Westinghouse Form-Fit design offers the maximum in mechanical, thermal and dielectric characteristics—at reduced size and weight.

YOU CAN BE SURE... IF IT'S Westinghouse

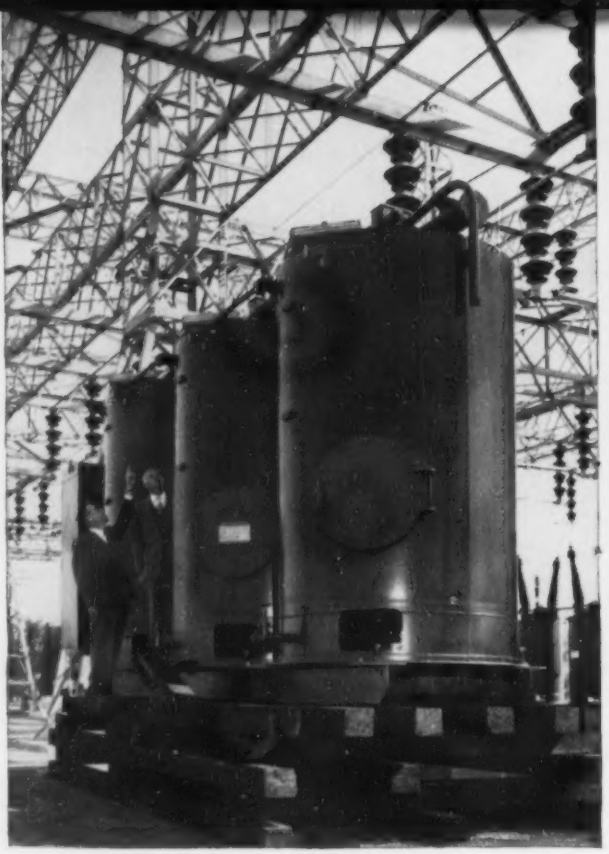
Marlowe Substation is ready for continued expansion

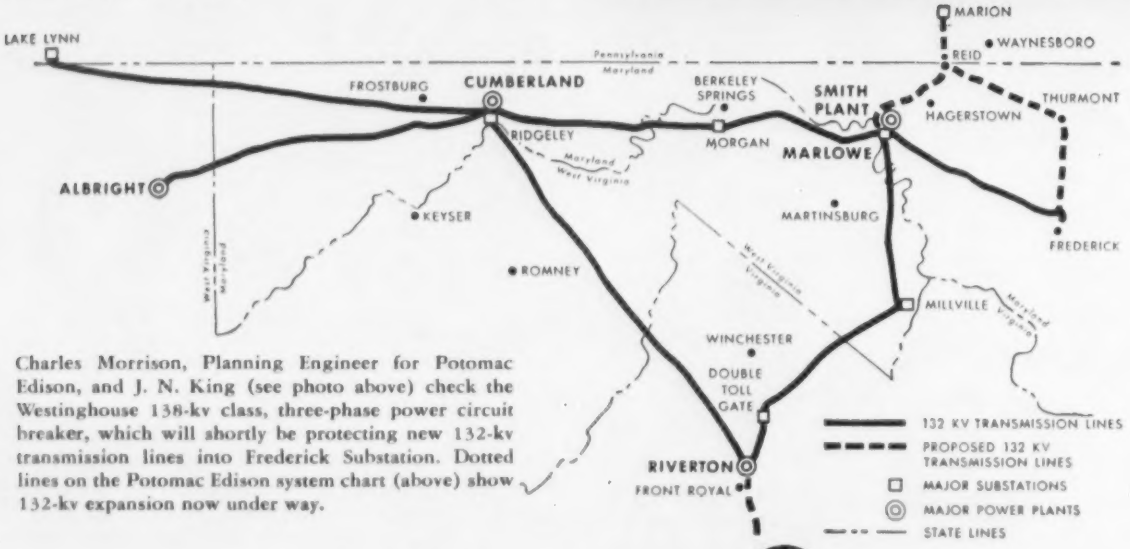
According to H. H. Startzman, Potomac Edison's load in 1933 was 46,350 kw; in 1943, it had jumped to 91,700 kw and 1953 ended with a total of 194,900 kw—more than a 300% increase in twenty years.

With the company actively engaged in all phases of civic and industrial development programs, Potomac Edison is preparing now for at least another 100% load increase by 1963.

Work is under way to extend 132-kv transmission to Marion, Pennsylvania, on the north . . . Thurmont and Frederick, Maryland, on the east, as shown in the system chart below

Marlowe Substation is designed to handle this growth with a minimum of changes and additions—an important factor in Potomac Edison planning. The added advantages of a completely "packaged" substation from one supplier—one responsibility—helped them considerably in meeting their increasing loads economically, without sacrifice of rigid standards of reliability. CP-1023



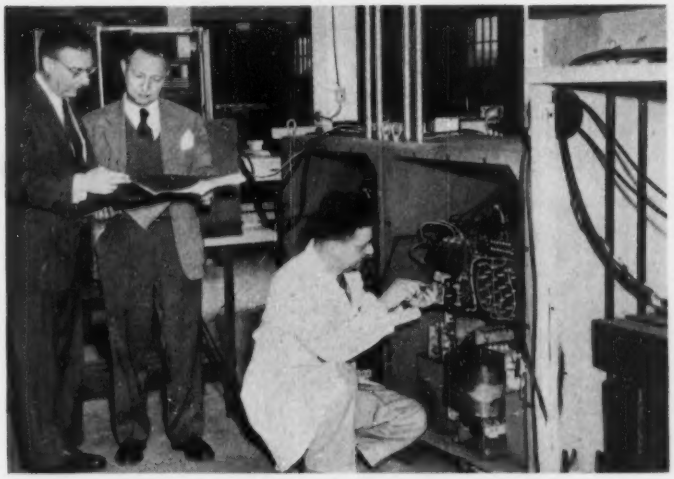


Charles Morrison, Planning Engineer for Potomac Edison, and J. N. King (see photo above) check the Westinghouse 138-kv class, three-phase power circuit breaker, which will shortly be protecting new 132-kv transmission lines into Frederick Substation. Dotted lines on the Potomac Edison system chart (above) show 132-kv expansion now under way.

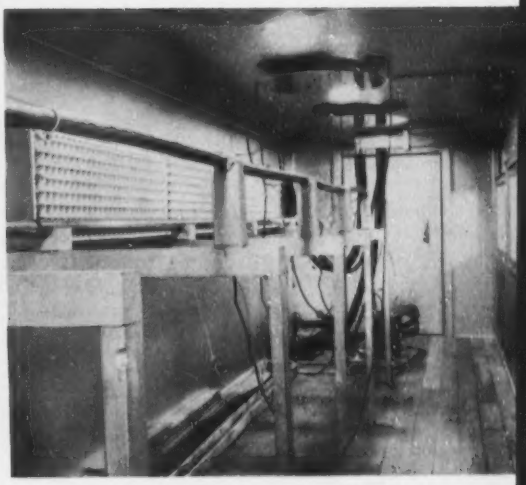
YOU CAN BE SURE... IF IT'S Westinghouse

Get complete product data on all products shown from booklets listed at right. Available through your local Westinghouse representative, or by writing direct to Westinghouse Electric Corporation, 3 Gateway Center, P. O. Box 868, Pittsburgh 30, Pennsylvania.

- ☐ Power Circuit Breakers..... B-4012, B-5834
- ☐ Power Line Carrier..... B-5873
- ☐ Microwave B-5850
- ☐ Power Line Carrier Relays..... LL 41-600.3, DB 41-412
- ☐ Power Transformers..... B-4142-A
- ☐ Instrument Transformers..... PL 45-000
- ☐ Line Traps..... DB 49-620
- ☐ Disconnecting Switches..... B-4726
- ☐ Power Fuses..... B-5469



LABORATORY PLANS are checked by L. F. Roehmann and Dr. E. W. Greenfield, research department director. Technician adjusts rectifiers that provide the power.



TEMPERATURE-CONTROLLED test room is heated electrically and cooled by refrigeration.

Kaiser Opens Conductor Lab at Spokane

A new laboratory for measuring electrical properties of conductors and materials covering them has been established by Kaiser Aluminum & Chemical Corp in Spokane, Wash. Believed to be the most advanced in the country, the conductor testing station will provide experimental crosschecks on calculated data. It consists of a test room, power sources, controls, and measuring equipment.

The 7 x 30 x 8-ft test room is heavily insulated and equipped with refrigerator type doors and double glass windows. It can be electrically heated to 60C and cooled by refrigeration to 4C. Thermostatic controls maintain temperature within ±1C except between 20 and 30C where closer control is obtained by operating both refrigerator and heaters.

Inside the room are water tanks for testing submerged cables and for insulation tests. A smoke exhaust is provided for overload and burn-off tests.

A wind machine having 12 fans on 1-ft centers provides a crosswind of 0 to 6 fps against the center test section of cable. Fans are controlled as a group by a central autotransformer and individually by small rheostats and a stroboscope.

Power . . . Power sources in the laboratory include two for ac and another for dc. One 2-kva ac source comprises a magnetic voltage regulator having a wave-shape distortion less than 3%, an autotransformer, a fine-control rheostat, and a 0-250/500-amp insulating transformer. The other ac source consists of a 60-kva, single-phase transformer having a 440-v primary and a 0-20-v, 0-3,000-amp secondary with stepless saturable reactor control.

The dc power is supplied by two, six-phase, 0-18-v, 0-1,500-amp selenium rectifiers with stepless saturable reactor control and voltage controller to hold output constant.

All controls, except for the smaller ac source, are centralized on a switchboard. A 0-3,000-amp switchboard ammeter permits current settings between 50 and 3,000 amp. It consists of a germanium rectifier-converter with a dc instrument having cut-pole pieces to provide the desired open scale.

Behind the switchboard are 3,000-amp aluminum bus bars having silver-plated connecting surfaces covered with sealing paste. Bolts are ½-in. aluminum alloy and are tightened to 30 ft-lb.

Instruments . . . Basic metering includes two Kelvin bridges to measure dc resistance and determine conductor temperature, a complex compensator to measure ac resistance and reactance, and a compensated wattmeter used as an alternative for ac resistance measurements.

One Kelvin bridge is a regular precision model with a range from 0.01 microhm to 1 ohm. Maximum current is 50 amp.

The other, a five-decade precision bridge with built-in lead compensator, was specially built and uses four fixed external manganin standard resistors that connect in series with the cable under test. The bridge will measure 0.001 microhms to 2 ohms. The manganin standard is kerosene-cooled, with a water-cooled heat exchanger, for 3,000-amp continuous loading.

The complex compensator consists of a precision current transformer and a conventional ac potential divider and Brooks mutual inductometer. A special, phase-discriminating cathode-ray oscilloscope was built for the null indicator.

For exceedingly low ac resistance (very large cable) the compensated wattmeter is used. Its current coil is connected to the current transformer and voltage is supplied from a phase-shifter like a selsyn. Part of this voltage is bucked against the cable voltage drop and the oscilloscope is used as null detector.

Other metering equipment includes precision shunts, current transformers, and dc and ac laboratory instruments. Switchboard meters serve only for preliminary adjustments.

Gas-Insulated Transformers . .

. . . are announced by General Electric. Two 69-kv units going to Consolidated Edison are claimed to have many advantages.

Future transformers may be lighter, quieter, and safer as a result of a new manufacturing development announced today by General Electric Co. This new step may also lead to the elimination of liquids for use as power transformer insulations and coolants.

The development, a joint project with the Consolidated Edison Co of New York, involves the first application of a high-dielectric gaseous insulation to high-voltage power transformers.

Sulfur Hexafluoride Gas Used . . . W. S. Ginn, general manager of GE's transformer department, said it foretells the eventual displacement of oil and askarel-filled transformer construction by gas-filled, dry-type construction. The new units filled with sulfur hexafluoride gas will be suitable for both indoor and outdoor installation.

Two of the new type units, rated 2,000 kva, 69 kv, are now on the drawing boards. When completed, they will be operated for field test experience on the Consolidated Edison company system.

New Unit Has Many Advantages . . . One of the main advantages of the new transformer will be its safer operating characteristics without the complications of liquid dielectrics. GE has been using Pyranol, a nonflammable liquid, in commercial and industrial transformer installations since 1932, but such units can not be rated over 46 kv.

Because pressurized gas is a much poorer transmitter of sound than a liquid, the new transformers are expected to have improved sound characteristics. Furthermore, the omission of oil and the reduced core and coil dimensions which may result from the gaseous insulation should produce lighter units.

Lynn Wetherill, manager of engineering, GE's transformer department, explained that prototype designs of the new transformer have been under development for more than two years. Until now, he said, dry-type transformers have been limited to ratings of about 15 kv. While nitrogen has been used in many transformers, its main purpose has been to exclude oxygen and water vapor rather than to improve the dielectric and cooling properties.

Laboratory investigations indicated that sulfur hexafluoride under moderate pressure offers considerable promise both as a dielectric and as a coolant. The Consolidated Edison units will utilize a gas-to-air heat exchanger to cool the gas after it is pumped through the core and coil assembly.

Ginn suggested that the practical application of gas as a high-voltage transformer insulation and coolant is probably the most radical change in transformer design concepts since the introduction in of non-aging silicon core steel which more than doubled transformer life.

He described the development—most of the engineering of which was handled by G. Camilli, a company engineer—and the part the New York utility has played and will continue to play as being typical of the forward thinking and planning which has marked the electrical industry during the past decades.

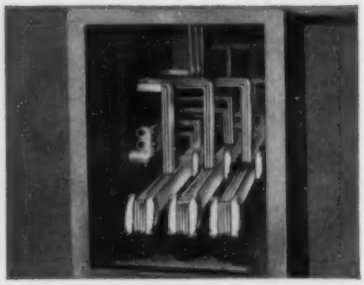
MANUFACTURING BRIEFS

Louis Allis Co has purchased a 36,000-sq ft, two-story warehouse in Milwaukee for storing electric motors.

Westinghouse Electric Corp will transfer its Lamp Division warehouse from San Francisco to larger quarters in the East Bay Area, at Emeryville . . . Westinghouse has opened a new Pacific Coast regional office in San Francisco for its appliance and TV-radio divisions and the Westinghouse Electric Supply Co. The office is at 1355 Market St . . . Westinghouse has opened a plant in Montevallo, Alabama, for the manufacture of welding electrodes. Employment will reach 100. . . . The Westinghouse research laboratories near Pittsburgh and the air conditioning plant at Staunton, Va. are nearing completion.

(*Advertisement*)

Electrical Applications of Aluminum



Aluminum Bus Conductor

More and more aluminum bus conductor is being used in prefabricated duct units for in-building distribution and for electrical and electronic control units. Aluminum's increasing use in electrical applications is due largely to its lower cost, high electrical conductivity, light weight with high strength, ease of fabrication and more certain availability.

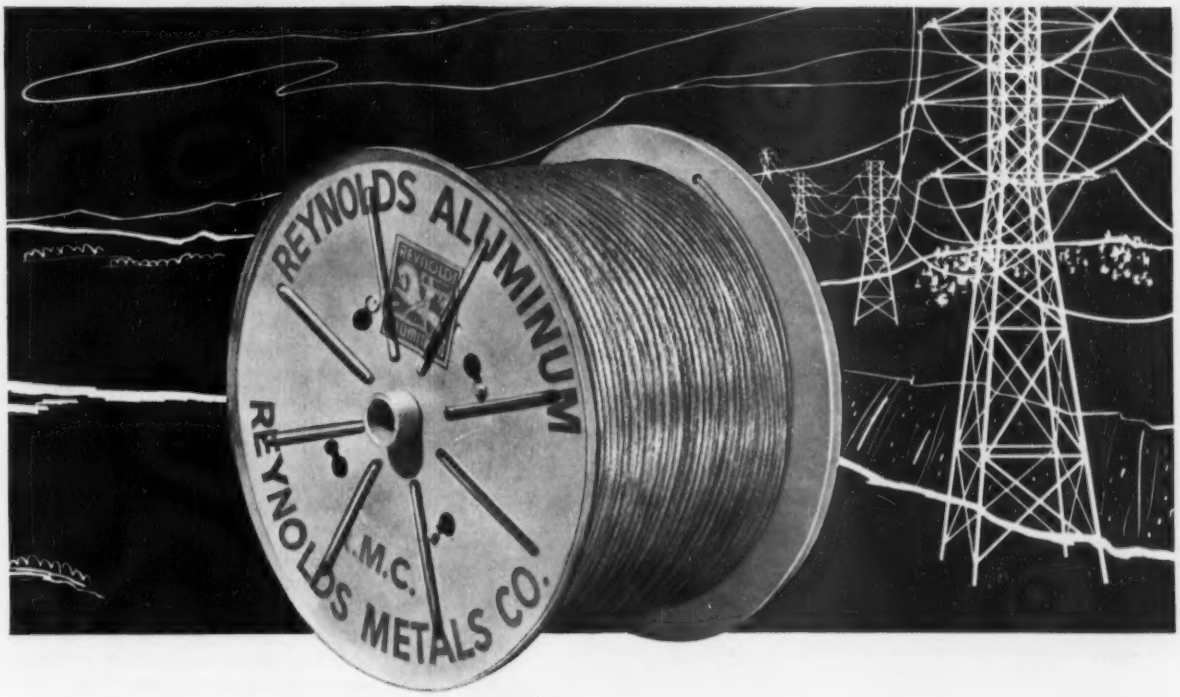
For assistance on your bus conductor designs, write to Reynolds Metals Company at the address on the opposite page.

An Engineering Service

The Reynolds Metals Company has an engineering service to help you on any type of electrical application for aluminum. For example, Reynolds engineers will conduct meetings with your men and provide them with the latest information on all phases of aluminum design and fabrication. This service is available without cost or obligation.

Reynolds treats each design, construction or production problem as a *new* problem. The Reynolds staff offers you the maturity of experience. Yet, unhampered by precedent, these are men who think in terms of tomorrow's needs *today*. Men whose vigor and skill combine with the latest production facilities and methods to help keep your quality standards highest, your costs low.

For full details contact your nearest Reynolds Branch Office or write Reynolds Metals Company at the address on the facing page.



ALUMINUM GIVES YOU MORE CONDUCTIVITY PER DOLLAR

The cable shown above is the famous Reynolds ACSR (aluminum cable steel reinforced) that not only costs less per pound than cables made of other materials but also gives you *more conductivity per dollar!* Furthermore, this cable is lighter by 20% so handling and field costs are reduced and stringing is easier and faster.

Along with its lightness, ACSR has strength and this combination enables you to go longer distances between structures (you can save up to four poles per mile), or because it has less sag you can lower structures.

This is a conductor of uniformly high quality. In production, each lot of aluminum is carefully analyzed to insure maximum conductivity and the steel core properties are controlled by rigid specifications. ACSR meets the most rugged service conditions.

This is an ideal example of how more and more aluminum is being used for more and more electrical applications. *Reynolds Metals Company, 2584 South Third Street, Louisville 1, Kentucky.*

"REYNOLDS ACSR FOR YOUR TRANSMISSION LINES"
Conforms to or exceeds ASTM and ASA specifications. Reynolds ACSR Manual for Engineers contains complete basic line design, sag, staking, and line erection information, charts and tables. This book is available without charge when requested on your business letterhead.

See "Mister Peepers", starring Wally Cox, Sunday nights on NBC-TV

REYNOLDS ALUMINUM

MODERN DESIGN HAS ALUMINUM IN MIND

THESE GREASED GRIPPING CHUCKS
HOLD
STEEL STRAND AND ACSR IN RELIABLE SPLICES AND DEADENDS

Single jaw for 3/8" steel strand has 165 teeth.
Cutaway showing complete gripping chuck assembly. Here's how floating jaws surround and HOLD conductor.

Single jaw showing two-level design for ACSR.

Extensive research has shown the way to make self-acting splices and deadends to HOLD even steel strand. These same basic principles are now applied to all other Reliable gripping chucks made to HOLD ACSR, copper and aluminum.

Look at the illustration of the jaw for 3/8" steel strand. Note the number of sharp teeth. This size chuck has 495 individual teeth that engage the wire instantaneously and HOLD permanently. Made in six sizes for No. 8 wire to 7/16" strand. They even HOLD such high tensile steels as are used in prestressed concrete construction (260,000 to 290,000 P.S.I.)

The second jaw above is for No. 2 ACSR and features the two-level design that permits the steel core and the aluminum conductor to be gripped and HELD by the same chuck. In this size a total of 84 individual teeth grip the steel core and 396 more surround and HOLD the aluminum strands.

The gripping chucks, used in Reliable splices and deadends, are designed and made to HOLD permanently. Tension applied momentarily, during installation, assures an electrical joint that is of less resistance than the conductor.

A momentary tension of about 15% of rated wire strength is enough to produce and maintain this low resistance joint.

Reliable ELECTRIC COMPANY 3143 Carroll Avenue Chicago 12, Ill.

Over 45 years service to the utilities

POWER LINE CONNECTORS AND CONSTRUCTION SPECIALTIES

Geneva: Brown Boveri and Co of Baden started building two 6,200-kw mobile plants on railway cars for the Mexican Comision Federal de Electricidad. One car will carry the gas turbine group with generator and starting motor. A second car will have a diesel engine for the turbine, the electric boards and switches, and a transformer for 13.8, 6.6, 4.16, and 2.4 kv.

West German manufacturers of electrical goods record a 40% rise in exports for the first half of 1954 and are optimistic about the second half . . . **Argentina** will intensify the importation of equipment needed for industry. The Central Bank will accept requests from the electric power industry for imports at official exchange rates and under installment buying from Germany and Switzerland. . . . **Toyko:** Hitachi Ltd will supply Cia Nacional de Energia Electrica, Brazil, with two 5,000 kw Kaplan turbines, two 6,250 kva generators, one each of 3,250 kva, 2,100 kva, and 400 kva transformers, circuit breakers, switch boards, cable, sluice gates, etc priced at $1,900,000 c.i.f. Santos. Delivery is to be within 13 months and payment in seven years. Equipment is for the Abania Darver station.

India: The Mysore government will manufacture high-voltage insulators here under an agreement signed with Japanese Nippon Gaishi Kaisha. The state's porcelain factory is expected to turn out 2,500 tons of electroporcelain annually under a $1,050,000 expansion program.

Manila: National Power Board has approved a $6-million award to the Philippine Engineer's Syndicate, Inc for construction of power facilities of the Ambuklao hydroelectric project. The contract involves construction of the power station, penstocks, spillways, and low-level outlet works. The syndicate has undertaken to complete the job in 550 days.

Johannesburg: About $38 million of non-Sterling and dollar currency is to be made available to importers in the Central African Federation. Imports of electrical equipment from the dollar area will be permitted. . . . **Tel Aviv:** The 1954/55 foreign currency budgets will make about $3 million available for industrial spare parts, including electrical.

SALES ASSIGNMENTS

COMPANY STAFFS

Graybar Electric Co, New York, has named E. N. Cundiff manager of the Toledo branch to replace A. W. Hallett, who will be assigned special duties in Cleveland. With Graybar since 1937, Cundiff previously served as manager of new business development at Cleveland.

C. O. Bartlett & Snow Co has appointed E. C. Hansen as manager of its new office at 2882 Delaware Ave., Buffalo, N. Y. He has been with the company since 1951 when he graduated from Case Institute of Technology. In addition to Buffalo, Hansen will service Niagara Falls, Schenectady, Rochester, and western New York State.

Babcock & Wilcox Co, New York, has designated Ralph K. Behr as manager of its Boiler Division's Boston district office effective Sept. 1. Behr, who has been attached to B&W's Chicago district office for 17 years, replaces H. K. Dean who is retiring after 31 years' service with the firm.

Line Material Co, Milwaukee, has made these field engineering organization changes: In the North Central Division, John R. Botts was transferred from the southern Minnesota territory to the northern Wisconsin territory. He will be headquartered at Green Bay, Wis., where he replaces Kenneth H. Newbury who has resigned. Charles B. Williams will make his headquarters at Minneapolis now that he has taken over the southern Minnesota territory of Botts. The South Dakota territory relinquished by Williams was divided among these field engineers: Erling A. Berget, operating from Sioux City, Iowa; Gerald O. Smith, from Bismark, N. D.; and Wilbur R. Coffin, from Fergus Falls, Minn. In the Southwest Division, Dennis A. Manning was transferred from Albuquerque to L-M's transformer plant in Zanesville, Ohio, where he assists Alvin B. Coyle, manager of transformer sales. Manning is succeeded by Robert E. Howell, who moves from the Houston office. Howell's area includes New Mexico and western Texas.

Permutit Co's Industrial Sales Department has appointed Robert Fay O'Connell as sales engineer for its St. Louis, Mo., office. He has served as a sales trainee in the firm's New York offices since 1953.

General Electric Co has named Neal F. Harmon as Southwestern regional manager for communication equipment with offices at Dallas, Tex. There he will direct the sales of GE two-way radio, microwave, and carrier current equipment in Texas, Arkansas, Louisiana, Mississippi, Oklahoma, and southeastern half of New Mexico. He formerly was sales manager of two-way radio equipment with headquarters at Syracuse.

REPRESENTATIVES

USCO Power Equipment Corp has appointed the following new sales representatives: Utility Products Co, 1022 Tipperary Drive, Dallas, Tex., to handle central and west Texas; Louis A. Goldbach Associates, 10 N. Main St., Chargrin Falls, O, to cover northern Ohio; Flynn & Pearson, 311 Frick Bldg., Pittsburgh, Pa., to handle western Pennsylvania, and L. C. Conover Associates, 1737 Chestnut St., Philadelphia, Pa., to cover eastern Pennsylvania and southern New Jersey.

THESE GREASED GRIPPING CHUCKS

HOLD

COPPER AND ALUMINUM CONDUCTOR IN RELIABLE SPLICES AND DEADENDS

Literally hundreds of teeth grip and HOLD the copper conductor.
Conductor is almost completely surrounded by the Reliable gripping chuck assuring an overall permanent grip.
Jaw used in Reliable deadends to HOLD aluminum strand or solid wire.

In developing gripping chuck jaws that HOLD high tensile steel strand, Reliable researchers developed new jaw designs that grip and HOLD permanently not only steel strand and ACSR, but also copper and aluminum. These designs are now used in all Reliable splice and deadend gripping chucks.

On each copper gripping chuck jaw for 2/0 copper conductor, there are 126 cold-forged engaging teeth or a total of 378 individual HOLDING points in each three-jaw chuck. The teeth, the chucks and the precision tapered cases are scientifically designed and precision made to HOLD permanently.

The aluminum jaw illustrated above is for No. 2-7 str. aluminum. The three-jaw gripping chuck is provided with 315 individual, keen-edged teeth that grip the strand instantaneously and HOLD permanently without damage to the strands.

A tight, low-resistance electrical joint is assured with Reliable splices when momentary tension is applied at time of installation. Reliable splices properly installed will actually run cooler than the conductors.

A momentary tension of about 15% of rated wire strength is enough to produce and maintain this low resistance joint.

Reliable ELECTRIC COMPANY 3145 Carroll Avenue Chicago 12, Ill.

Over 45 years service to the utilities

POWER LINE CONNECTORS AND CONSTRUCTION SPECIALTIES

WHEN YOU WANT SERVICE...

SPECIFY

BERMICO®

LIFETIME CONDUIT

For *real* service—prompt, efficient service—specify Bermico. Many Westinghouse Electric Supply Company offices carry, for immediate shipment, large, well-balanced stocks of all sizes, together with fittings for any situation you may encounter in installing underground ducts.

With Bermico Lifetime Conduit you get the greatest possible protection for your cable—at low cost. It means fewer outages, uninterrupted service for your customers, less expense for you.

Made from sturdy wood fibre, impregnated with pitch, Bermico is *completely uniform* from end to end. It is light, tight, strong, acid-resistant, with *uniformly smooth* bore. For best protection for your cable specify Bermico.

Distributed by WESTINGHOUSE Electric Supply Company

Offices in principal cities

BROWN COMPANY, Berlin, New Hampshire
CORPORATION, La Tuque, Quebec

General Sales Offices: 150 Causeway Street, Boston 14, Mass. • Dominion Square Building, Montreal, Quebec

SOLKA AND CELLATE PULPS • SOLKA-FLOC • NIBROC PAPERS • NIBROC TOWELS • NIBROC TOWETTES • NIBROC TOILET TISSUE • BERMICO SEWER PIPE AND CONDUIT • ONCO INSULA CHEMICALS

Meetings Calendar

(*Continued from page 68*)

INDIANA ELECTRIC ASSOCIATION
Annual Convention, French Lick Springs Hotel, French Lick, Ind., Oct. 6-8.

CONTROLLERS INSTITUTE OF AMERICA
Annual Meeting, Edgewater Beach Hotel, Chicago, Oct. 10-13.

***IOWA UTILITIES ASSOCIATION**
Annual Management Conference, Hotel Fort Des Moines, Des Moines, Iowa, Oct. 11-12.

INTERSTATE POWER CLUB
Meetings will be held at Hotel Martinique, New York, on following dates: Oct. 11, Dec. 6.

NATIONAL INDUSTRIAL CONFERENCE BOARD
Third Annual Conference on Atomic Energy in Industry, Hotel Commodore, New York, Oct. 13-15.

NATIONAL SAFETY CONGRESS-EXPOSITION
Conrad Hilton Hotel, Chicago, Oct. 18-22.

OKLAHOMA UTILITIES ASSOCIATION
Electric Light and Power Division, Western District Meeting, Duncan, Okla., Oct. 21; Eastern District Meeting, Ada, Okla., Oct. 22; Annual Convention, Mayo Hotel, Tulsa, Okla., March 24-25, 1955.

PUBLIC INFORMATION PROGRAM
Workshop Conference, Chase and Park Plaza Hotels, St. Louis, Oct. 27-29.

***AMERICAN WELDING SOCIETY**
National Fall Meeting, Sherman Hotel, Chicago, Nov. 1-5.

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION
Annual Meeting, Haddon Hall Hotel, Atlantic City, N. J., Nov. 8-11; Winter Meeting, March 7-11, 1955.

NATIONAL ASSOCIATION OF RAILROAD AND UTILITIES COMMISSIONERS
Annual Convention, La Salle Hotel, Chicago, Nov. 8-12.

AMERICAN STANDARDS ASSOCIATION
36th Annual Meeting and 5th National Conference on Standards, Hotel Roosevelt, New York, Nov. 15-17.

***WISCONSIN UTILITIES ASSOCIATION**
Electric-Gas Sales and Engineering Convention, Schroeder Hotel, Milwaukee, Nov. 17-19.

***NATIONAL FARM ELECTRIFICATION CONFERENCE**
1954 Meeting, Van Curler Hotel, Schenectady, N. Y., Nov. 18-19.

21ST NATIONAL POWER SHOW
Sponsored by American Society of Mechanical Engineers, Commercial Museum, Philadelphia, Dec. 2-7.

EASTERN JOINT COMPUTER CONFERENCE-EXHIBITION
Sponsored jointly by American Institute, of Electrical Engineers, Institute of Radio Engineers, and Association for Computing Machinery; Bellevue-Stratford Hotel, Philadelphia, Dec. 8-10.

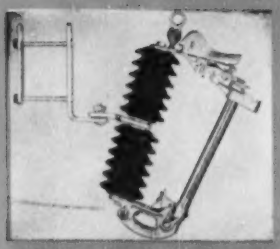
ELECTRICAL EQUIPMENT REPRESENTATIVES ASSOCIATION
Annual Meeting, Breakers, Palm Beach, Fla., Jan. 10-12, 1955.

NATIONAL ASSOCIATION OF PURCHASING AGENTS
24th Annual Mid-Winter Conference, Public Utility Buyers' Group, Shamrock Hotel, Houston, Tex., Feb. 13-15, 1955.

SOUTHERN SAFETY CONFERENCE-EXPOSITION
Jung Hotel, New Orleans, La., Feb. 27-March 1, 1955.

AMERICAN POWER CONFERENCE
17th Annual Meeting, Sherman Hotel, Chicago, March 30-31, April 1, 1955.

*Additions this week.



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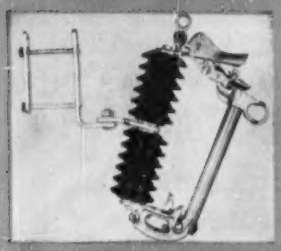

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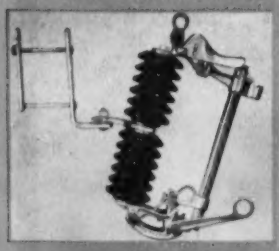

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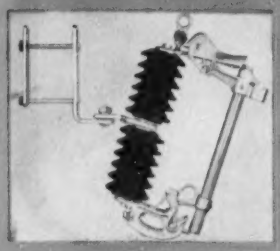

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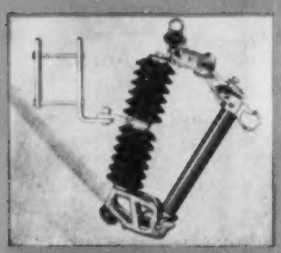

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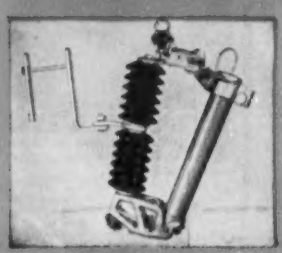
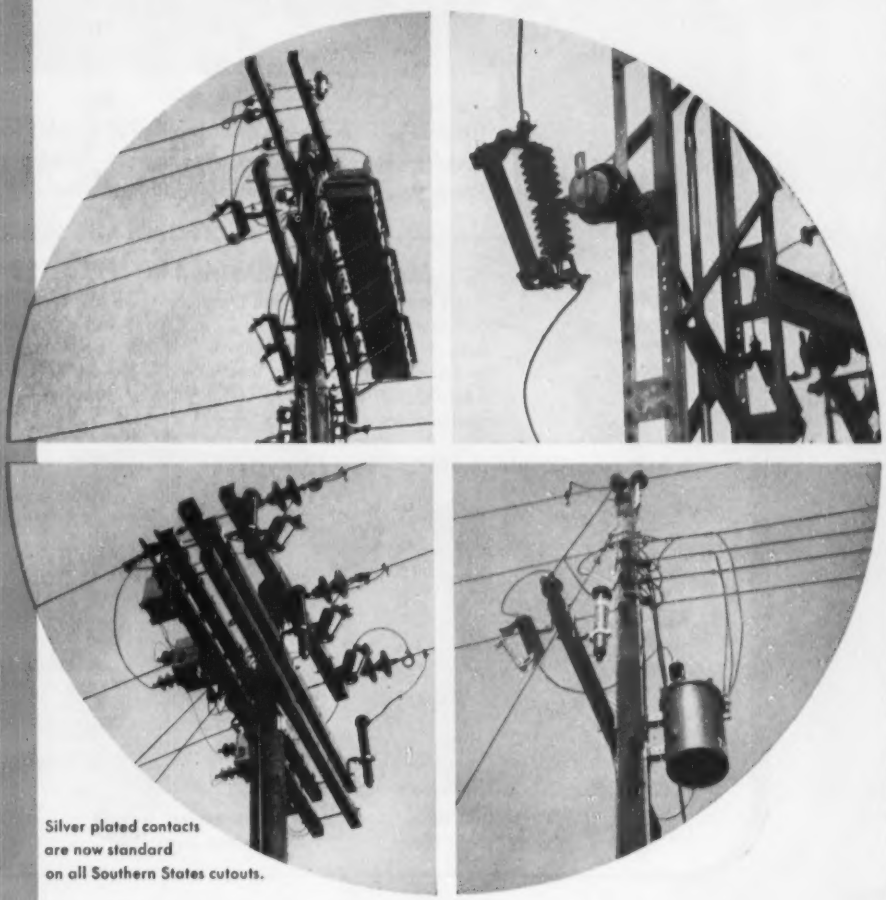


Type HH-33-D

58 Combinations

to meet your cutout requirements



Silver plated contacts are now standard on all Southern States cutouts.

No matter what your fusing problems are—excessive load-growth, isolated or special applications, meeting a tight budget, or others—Southern States cutouts will help you lick them. In the 33 series, fifty-eight combinations of voltage, current and interrupting ratings are available.

From this versatile line—ranging from the Type 33-D, to the extra heavy-duty, Type HH-33-D—you can select the cutout that meets your exact requirements.

Three methods of tube venting, interrupting ratings from 1,200 to 25,000 RMS amperes and continuous current ratings from 50 to 300 amperes, enable you to choose the cutout you need.

Complete data and information are available in our Bulletin 530-C, which we'll gladly send you on request.

Specify Southern States cutouts and be certain.

SOUTHERN STATES EQUIPMENT CORP.

HAMPTON, GEORGIA

Check the EXPANDED

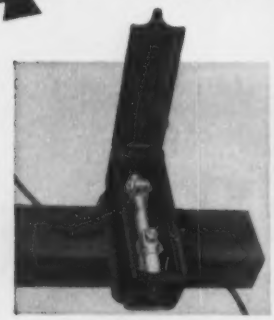
for Open-Link, Fuse-Tube,

Chance plus Matthews equals a line of cutouts for practically every requirement. And when you specify Chance *or* Matthews, you know you're getting quality equipment.

MATTHEWS PORCELAIN-ENCLOSED CUTOUTS

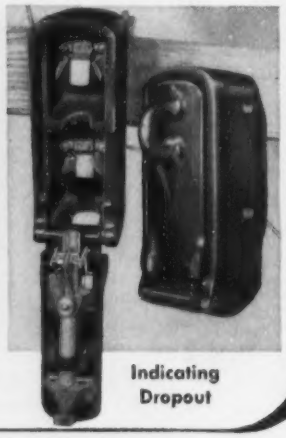
Made in two indicating and three non-indicating types. Drop-down indication (left) keeps door closed. Dropout Cutout (below) releases door when fuse melts. Non-indicating types have fuse tubes mounted on permanently hinged (or removable) door or in the housing — leaving door free. 50 to 100 amp., 5 to 7.5 KV. Interrupting cap., 1200 to 3000 amp. Bulletin 103-C gives complete details.

INDICATING DROP DOWN

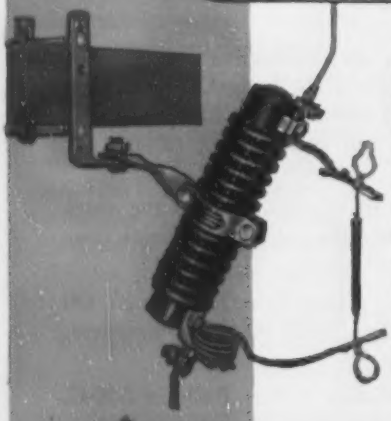


Non-Indicating with "Free" Door

Non-Indicating, Removable Door



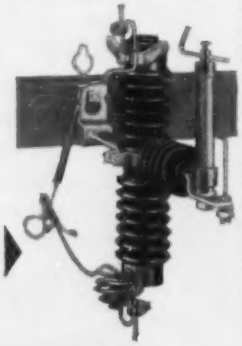
Indicating Dropout



MATTHEWS (PROTECTOLINK) CUTOUTS

Have spring-type contact arms with wedging fuse contacts that fit all makes of open link fuses. Patented, horizontally coiled spring design of the lower arm has exceptional ice-breaking ability — each individual coil flexes when fuse link separates. 50 amp., 7.5 and 15 KV. Also available with gap protection, and in types for transformer mounting.

Protectolink-Protectogap combination has adjustable gap



CHANCE SUSPENSION CUTOUT

Low-cost protection for 2,300 to 15,000 volts. Hangs on conductor like a tap clamp. Indicating fuse ejector.

A·B·CHANCE CO·

CENTRALIA, MISSOURI • SAN FRANCISCO, CALIFORNIA

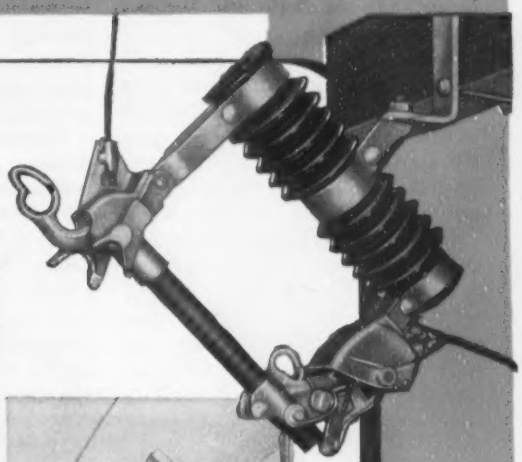
CHANCE LINE Now...

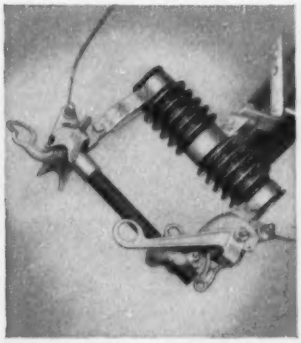
Porcelain-Housed Cutouts

the CHANCE *KO* CUTOUT

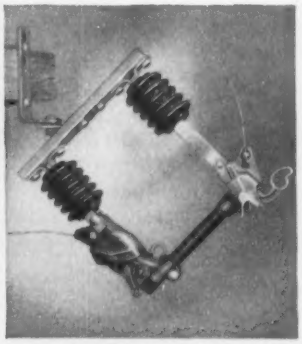
the cutout designed with load-break in mind

Chance KO Cutouts give *unfailing protection* throughout their entire operating and interrupting ranges which makes them adaptable to load-break operation. Because of its "kick-out" feature, linemen and troubleshooters can tell at a glance if the KO was opened manually or by a protective operation. At right is Type KO, 7.5 to 15 KV, 100 amp., with 3000 amp. interruption. Also available in heavy duty model with 5000 amp. interruption.

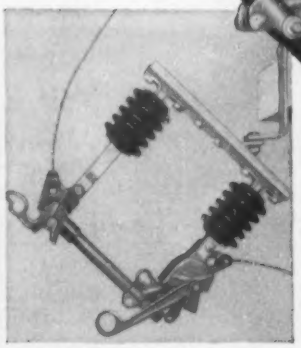




Type KO-L (Load-break). 7.5 to 15 KV. 100 amp., 3000 amp. interruption. Also 5000 amp. interruption, Type KO-HL.

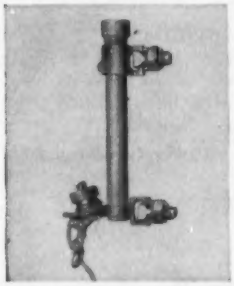


Type KO-TH. 7.5 to 15 KV. 100 amp. 3000 or 5000 amp. interruption.



Type KO-THL (Load-break). 7.5 to 15 KV. 100 amp. 3000 or 5000 amp. interruption.

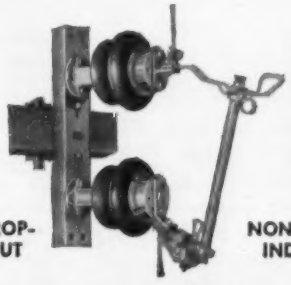
MATTHEWS SECONDARY CUTOUTS



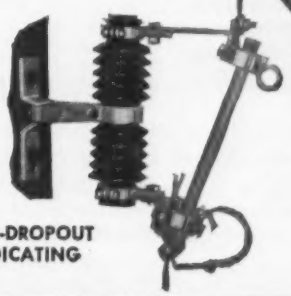
Designed for low-cost sectionalizing, isolating service entrance faults, or transformer protection. See Bulletin 101-E.

MATTHEWS OPEN TYPE (Fuse Tube) CUTOUTS

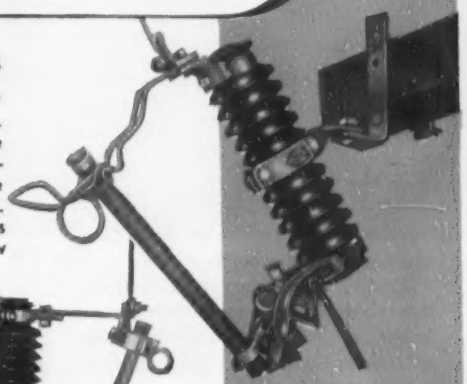
Made in dropout and non-dropout types, single or double insulator, 5, 7.5, 15 and 23 KV, 100 amp. Interrupting cap., 2000 amp. Dropout types have sturdy one-piece upper contact arm and a substantial hinge end mechanism that causes fuse tube to drop and swing down as the fuse link is ejected. Pullink fuse ejectors on the "non-dropout" types serve as indicators and speed fuse ejection on low current faults.



DROP-OUT



NON-DROPOUT INDICATING



DROPOUT

NEW EQUIPMENT

Cable Splicing Kit

Cable splices under field conditions are made quickly and easily using a new splicing and insulating method. It involves embedding the splice in liquid epoxy resin that hardens into a hermetically sealed casting. No heat is required.

Basis for the new method is Scotchcast No. 4 electrical embedment resin supplied in Splicing Kit No. 82A with all other materials necessary for making a complete cast splice in single-conductor cable, 10 to 4 AWG. Only tool required is a pocket-knife.

In use, the mold pieces are slipped on the ends of the wire, the insulation penciled down, and the spring connector turned on with the fingers. After pulling the plastic mold units into place over the connection, the inner partition in the Unipak container is ruptured by squeezing, and the resin and hardener thoroughly mixed by kneading the contents.

When the resin assumes a uniform color, a corner is nipped off the envelope and the activated resin poured into one of the mold spouts. Within 5 to 15 minutes the resin sets up. The plastic mold is left in place, since it provides added protection.

Properties of the resin include a dielectric strength of 800 v/mil; electrolytic corrosion factor of 1.0; dielectric constant of 7.2 and dissipation factor of 0.019 at 30 C; and good resistance to water, oil, solvents, and weathering. The material is self extinguishing.

Minnesota Mining and Manufacturing Co, 900 Fauquier St, St. Paul 6, Minn.

Aluminum Bus Conductor

Improved mechanical properties are combined with high conductivity and workability in Reynolds aluminum bus conductor (RABC). Tensile strength of RABC is 29,000 psi compared to 17,000 for the hardest temper of electrical conductor aluminum (EC-H17).

Other comparisons of RABC to EC are: yield strength, 25,000 vs 15,000 psi; conductivity, 55 vs 61% IACS; resistivity at 20 C, 14.82 vs 13.36 microhms per sq in./ft; and temperature coefficient of resistance in percent per deg C at 20 C, 0.360 vs 0.403.

The added strength to withstand short-circuit forces allows use of RABC bus with the same spacing of supports as used for copper.

Reynolds Metals Co, 2500 S. Third St, Louisville 1, Ky.

ITV Camera

The UtiliVue industrial television camera, Series 400, can be used with either a Video monitor or with a standard television receiver for closed-circuit television. It can be tuned to any channel from 2 to 6.

All controls and power supply are built in—no separate power unit or multiconductor cable is needed.

The camera has automatic illumination compensation and voltage regulation. It can be supplied with either a Utilicon (long life cold cathode) or a Vidicon pickup tube.

Features claimed include uniform picture quality and operating stability. Several receivers can be fed.

The UtiliVue is distributed by Graybar Electric Co. Details in Bulletin 1175.

Diamond Power Specialty Corp, Box 415, Lancaster, Ohio

Volt & Amp Recorder

Wide-strip electronic recorder measures and records both current and voltage simultaneously on one chart. Primary measuring elements are a thermal-voltage converter and a thermal-current converter, ac/dc transducers. This Dynamaster Electronic Potentiometer has fast response time, accuracy within 1%, and sensitivity of 0.05%.

Half the chart records amperes, the other half volts. Calibration is square-law, giving expanded graduations in the normally used section. Easily changed gears allow chart speeds from ¾ in./hr to 4 in./sec.

High torque output allows addition of auxiliary functions, such as high-alarm contacts or retransmitting slidewires.

The Bristol Co, Waterbury 20, Conn.

Four-Wheel Drive

Four-wheel drive is now available on lighter trucks, Chevrolet ¾ and 1-ton trucks. These vehicles with Powr Pak are suited for transportation of personnel, equipment, etc for utility companies and others.

NAPCO Products Div., Northwestern Auto Parts Co, Minneapolis, Minn.

Steel Caliper

Pocket-size stainless steel caliper gives direct reading of conductor sizes, 18 AWG to 2,000 Mcm stranded commercial cable, 20 to 4/0 solid, and 6 AWG to 336.4 Mcm ACSR. It measures rigid conduit and copper pipe from ¼ to 2½ in., and thinwall conduit from ⅜ to 2 in.

The Wire-Mike is also an inside and outside caliper in 1/32 inches and a 3½ in. rule. A conversion table of pipe sizes to inside dimensions is included. It weighs 2 oz, has overall length of 4½ in. when closed, and is provided with a leather slip case.

Burndy Engineering Co, Inc, Norwalk, Conn.

Squirrel Guard

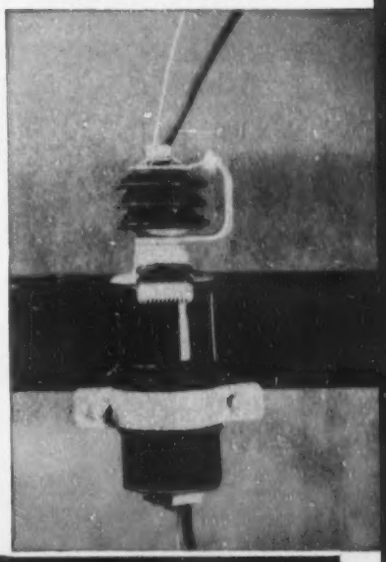
A transformer "squirrel guard" is designed to overcome the trouble caused by birds and animals creating outages. The funnel-shaped guard is formed of wet process porcelain,

Hubbard Autogaps

make the big difference...

CONVENTIONAL ARRESTER

HUBBARD AUTOGAP

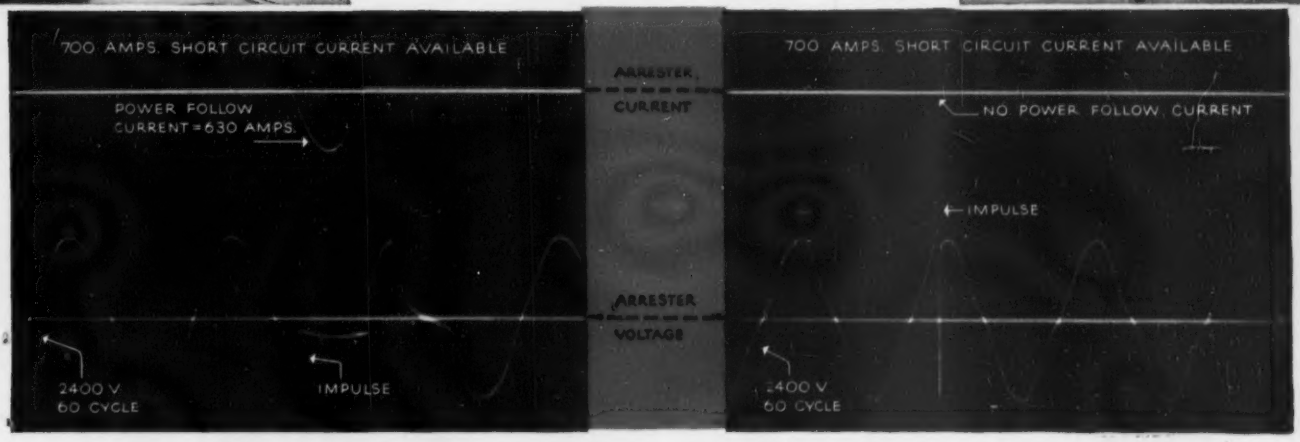


The AUTOGAP is the one lightning arrester available for *all* system conditions. In the twin vented Autogap a unique fibre barrier plug develops adequate deionizing gas pressures from the lightning current, while all other expulsion arresters normally require the additional action of power follow current for equivalent pressures.

The Autogap Arrester has a lightning capacity of 150% of the standard minimum requirements and has a negligible discharge voltage for any lightning current. It is therefore suitable for systems with the most extreme lightning exposure.

Each rating has an impulse sparkover characteristic that provides approximately a 50% safety factor for the new equipment insulation. It is therefore recommended for the protection of all equipment, old or new.

Both arresters illustrated were photographed while under identical test conditions. The "conventional" arrester temporarily shorted the system while the Autogap conducted lightning only.



CONVENTIONAL ARRESTER . . . Above oscillogram and photograph were recorded during a duty cycle test of a 3 KV "conventional" arrester. The large volume of expulsion gases, blowing out the bottom and representing consumed fibre, is a result of the 630 amps. of arrester power follow current. The test shows typical "conventional" arrester duty cycle operation.

HUBBARD AUTOGAP . . . Above oscillogram and photograph were recorded during a duty cycle test of a 3 KV Autogap arrester. Note that the arrester conducted the surge current only, hence the conspicuous absence of expulsion gases. The test shows typical Autogap duty cycle operation.

Proven: Autogap superiority has been demonstrated in impartial field tests conducted by utility companies; in exhaustive laboratory tests; in over 14 years success-performance record from coast to coast.

- Highest lightning capacity for intense or long duration surges.
- Lowest discharge voltage. *Exclusive twin vent.*
- The only arrester, valve or expulsion, that prevents power follow current.

HUBBARD AND COMPANY

ESTABLISHED 1843

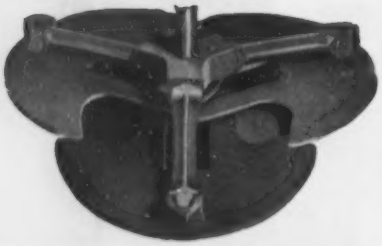
PITTSBURGH • CHICAGO • OAKLAND, CALIFORNIA

"Hang the Load on Hubbard Hardware!"

The Old Reliable

EVERSTICK ANCHORS...

EXTRA Holding Power
QUICKLY Installed
TOUGH For long life



● They speed up work and provide dependable anchorage in new construction and maintenance. Quick and easy to install—made of tough rust-resistant malleable iron—their holding power "tops" all others. Available two-way, three-way, four-way, and cone types. Write for facts.

AN EXCLUSIVE
EVERSTICK
FEATURE
Exclusive Everstick nut housing. Locks anchor firmly on rod. No chance of rod slipping thru anchor.

EVERSTICK ANCHOR CO.
Manufacturer of "THE ANCHOR OF MERIT"
FAIRFIELD, IOWA

brown glazed. It fits over transformer bushing and approximately doubles the distance from hot to grounded parts, reducing the danger of birds or animals shorting out the bushing.
Hubbard & Company, 6301 Butler St, Pittsburgh 1, Pa.

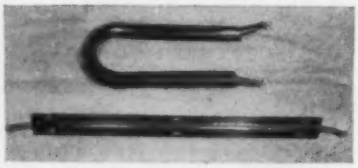
Safety Hook

Utility hook has a safety gate that may be opened or closed by "hot line" equipment. It may be locked open or locked closed by hot tools or by hand. The B-B utility safety hook is available in three sizes. No. 1, primarily for use by linemen on safety belts and hand tools, has a safe working load of 1,000 lb. No. 3, for use on 3-in. blocks using ½-in. rope, is rated 1,700 lb. No. 4, for 4-in. blocks and ⅝-in. rope, is rated 2,400 lb. (Bulletin 54)
E. D. Bullard Co, 275 Eighth St., San Francisco 3, Calif.

NEMA 12 Enclosure

NEMA 12 enclosure assures dependable circuit breaker operation in atmospheres containing particles of lint, dirt, sawdust, and other foreign matter. Mounting holes and knockouts are omitted to prevent foreign matter from entering the unit. External mounting feet simplify installation.

Sides and back have closed welded seams. Finish is bonderized enamel. Neoprene gasket assures tight seal when cover is shut. Mechanism operates breaker from outside enclosure. Enclosures are available with I-T-E E, F, J, and L frame circuit breakers —in ratings from 15 to 600 amp, 125-600 v ac, 125-250 v dc.
I-T-E Circuit Breaker Co, 19th & Hamilton St, Philadelphia 30, Pa.



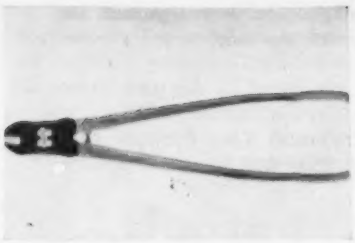
Vane-Type Heater

Vane-type Calrod heater is for air and surface heating. Applications include pipe, platen, valve and pump, process machinery, compound tanks, and machine surface heating. A 0.315-in steel-sheath Calrod heater is brazed into a U-shaped depression in a 1¾ x 1/16-in. steel vane. Heaters are rated 25 w per linear inch, and are supplied in lengths from 20 to 100 in., 500 to 2,500 w, for either 115 or 230 v.
General Electric Co, 1 River Rd, Schenectady 5, N. Y.

Mobile Electric Lift has 40-ft Reach

Designed for one-man operation, mobile electric lift with 40-ft reach is designed for servicing overhead power lines and street lights. Lift is powered independently of truck engine by gasoline-driven generator set. It has dual controls—in rotating base and on elevating work platform.

The unit may be mounted by four bolts on any dual-wheel truck of one ton or greater capacity. One motor raises and lowers boom, another telescopes it, and a third rotates it. Lift is also built with 30 and 60-ft booms.
Testa Corp, Sunnyvale, Calif.



Guy Cutter

Tool is desgined to cut high-strength guy wire, cores of ACSR, and static wire. All parts are designed and heat treated to resist twisting and to give long wear life. Sizes are available for cutting up to ½-in. diameter.
Interstate Drop Forge Co, 4051 N. 27 St, Milwaukee 16, Wis.

Rural Regulator

Pole-mounted, single-phase rural regulator has four 2.5% steps. Sizes are 15 and 25 amp, 7,620 v, for use on multi-grounded wye circuits of 6.9/11.95 to 7.96/13.8 kv. Two taps allow 120-v control voltage for either 7,620- or 7,200-v primary. Adjustable contact-making voltmeter keeps any level between 110 and 130 v at recommended bandwidth of ±2 v.

Features include rugged tap-changing mechanism and indicator readable from the ground, round-wound core and coil in Orto, voltage control mountable on pole base or tank, common ground terminal on tank, and lightning arrester across series coil. Line arrester is optional.
Line Material Co, Milwaukee 1, Wis.

Electric Hoists

Cable Quik-Lift electric hoists range in capacity from 500 to 4,000 lb with a choice of lifting speeds and types of suspension. They have push-button control; large, separate load and motor brakes; foolproof limit switch; and other safety features, including safety hooks. (Bulletin CQ)
Coffing Hoist Co, Danville, Ill.

Anti-Oxident

Anti-oxident is packaged under pressure in an easy-to-use spray can that may be carried on the lineman's

Rugged HUBBELL® Twist-Lock

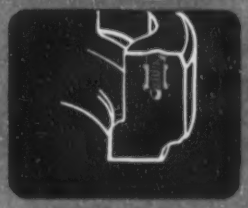
No. 7313 CONNECTOR BODY

FIRST AND STILL THE FINEST BECAUSE . . .

No. 7311 CAP

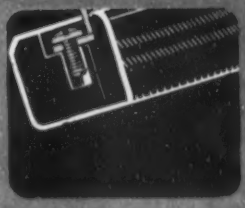
Heavy Duty Construction

SOLID BRASS MOLDED-IN INSERTS HOLD CONNECTOR BODY TOGETHER SECURELY



Trouble-Free Wiring

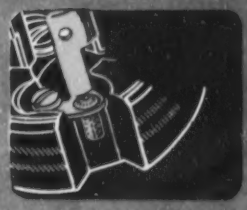
UPSET BINDING SCREWS CAN'T COME OUT!



"Red-Rock" Blade Stability

BLADES SOLIDLY ANCHORED WITH MOLDED-IN KNURLED RIVETS

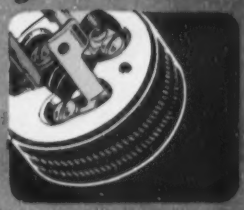
LARGER SPUN-OVER AREA



"Speed-Easy" Wiring Convenience

HEAVIER SCREWS LARGER BINDING HEADS

TERMINALS RECESSED IN CAP FOR EXTRA WIRING ROOM



Armour Plate Protection

RUGGED STEEL ARMOUR PLATE SHELL FOR MAXIMUM PROTECTION AGAINST BREAKAGE

Adjustable Cord Grip

ADJUSTABLE, STOUT HOLD-TITE CORD GRIPS TAKE STRAIN FROM BINDING SCREWS

For greater Convenience, Safety, and Efficiency in the operation of motor-driven tools or portable electrical apparatus. The locking action insures positive contact in spite of rough treatment, heavy vibration, and other conditions that might cause down-time. Available in two-wire, three-wire and four-wire sizes. Three and four-wire sizes available grounded and not grounded.

Highest Grade HEAVY DUTY WIRING HUBBELL DEVICES

Dept. E-2

HARVEY HUBBELL, INC., BRIDGEPORT, CONNECTICUT

26HH54

as at the

ALBRIGHT STATION*

Monongahela Power Company
Fairmont, West Virginia

Units #1 and #2 are in operation. The fans for Unit #3 have been designed and are being constructed. They will be larger than the fans for the first two units. Boiler #3 will operate on the same type of fuel (pulverized coal) and is expected to generate one million pounds of steam per hour.

Each boiler now in service is served by two Forced Draft and two Induced Draft Fans with the following specifications:

F. D. Fans Double inlet with radial inlet vanes; outlet dampers; rain hoods and recirculating duct connections. Capacity for each fan: 110,500 cfm; 100 F; 14.7" SP; 1180 rpm; 348 hp.

I. D. Fans Double inlet, special control type inlet dampers and outlet dampers. Capacity of each: 187,000 cfm at 350 F; 13.5" SP; 880 rpm; 566 hp.

Green Fans can show an excellent record of efficiency and durability. They can be found in many of the leading and recently completed utility and industrial power plants. They have back of them a fund of knowledge about fan requirements and fan design. They serve their users well.

Our Catalog No. 168 tells all about G.een Fans. Write for a copy.

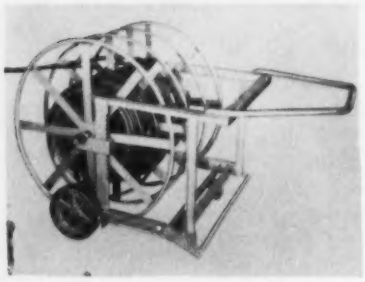
*Sanderson & Porter, Engineers

THE GREEN *Fuel Economizer* COMPANY INC.

- Economizers
- Fans
- Air Heaters
- Cinder traps
- Aerodynamic Dust Collectors

BEACON 3, NEW YORK

belt. This Sprayox is suggested for retarding oxidation and corrosion on splices, taps, connectors, armor, etc. Each case of 12 also contains two belt holders. (Bulletin 95-201)
Preformed Line Products Co, 5349 St. Clair Ave, Cleveland 3, Ohio



Reel

Compartmented reel, in conjunction with a Reel-O-Matic unit, can be loaded in the warehouse with proper lengths in each compartment, saving measuring and cutting on the job. It is claimed that one man alone is then able to pull the cable. Reel capacity is 750 CML.
Columbia Industries, Inc, Columbia, Pa.

750-Amp Plater

Model 6-750T selenium-rectifier type plater is rated 750 amp, 0-6 v dc in 22 steps. Unit has down-draft ventilation with airflow-switch protection.

Unit is designed for 230/460 v, 3-phase, 60 cps input. Overall dimensions are 66 x 22 x 22 in. A magnetic starter, overload protection, and meters are provided. Dc ripple is 5% maximum. Weight is about 800 lb.
Crown Chemical and Engineering Co, 4722 Worth St, Los Angeles 63, Calif.

Telemetering System

Impulse-duration telemetering system transmits and receives, over long distances, measurements of process flow, pressure, liquid level, temperature, or other variables. It operates up to 150 miles by wire or may be operated over radio or microwave channels.

Telemeter transmits a pulse every 12 seconds, proportional in duration

guaranteed footage ...*plus*

You get full measure with every roll of Jenkins Gold Seal Tape.

But what's even more important, every inch measures up to the Gold Seal standard, which makes every roll go further. It has lasting "tack" in any weather.

A few neat wraps and the job's finished . . . one thickness insulates. Get the most "coverage" per roll . . . specify Gold Seal.

Jenkins Bros. (Rubber Division),
100 Park Ave., New York 17.

JENKINS
GOLD SEAL TAPE
FOR EVERY JOB

Available in 10-roll cartons or single rolls. Every roll cellophane protected to stay factory-fresh.

JENKINS
Gold Seal Tape

Jenkins Bros. also make Diamond Seal Friction and Rubber Tapes which meet ASTM Specifications.

A PRODUCT OF JENKINS BROS....

MAKERS OF FAMOUS JENKINS VALVES

You Don't Have to "BABY" the

DIAMOND "UTILISCOPE"®

(WIRED TELEVISION)

IT CAN TAKE IT

Operator SEES interior of cement kiln in comfort while "Utiliscope" camera watches in intense heat.

Dirt, vibration, heat are taken in stride by the Diamond "Utiliscope" (wired television). Hundreds of installations in power plants, steel mills, cement plants, coal mines, and a wide variety of manufacturing plants have proved its ruggedness and durability.

Have you investigated the Cost-Cutting Benefits of the "UTILISCOPE"? Mail the coupon for New Ideas

"UTILISCOPE" CAMERA

6944

DIAMOND POWER SPECIALTY CORP. W
LANCASTER, OHIO

Please send me without obligation a copy of new Bulletin No. 1136 showing how the Diamond "Utiliscope" (Wired Television) is being used to cut costs, improve operations and promote safety.

Name_____

Company_____

Address_____

DIAMOND POWER SPECIALTY CORP.
FIRST IN INDUSTRIAL TELEVISION
LANCASTER, OHIO
OFFICES IN 39 PRINCIPAL CITIES
Diamond Specialty Limited — Windsor, Ontario
Since 1903, Diamond has Manufactured Quality Equipment for Industry

to the variable being measured. The receiver automatically compares the duration of this pulse to that of the previous one and actuates a reversible motor to position a recorder pen or indicator to reflect any measurement change. Details in Technical Information 33-A-85a.

Foxboro Co., Foxboro, Mass.

Oven

Electric recirculating oven is designed for temperatures to 650 F. Open-type elements are located in the bottom; air is recirculated by one or two stainless steel blowers. Various types of temperature control and sizes of oven are available.

K. H. Huppert Co, 6830-32 Cottage Grove Ave, Chicago 37, Ill.

Safety Lockout

Multiple lockout device for switch and fuse boxes allows up to six padlocks—where a number of men are working the current may not be turned on until the last man has completed and removed his lock. The device is fabricated of cold rolled steel, zinc iridite plated. It opens and closes in scissors fashion. Jaws at either end provide a secure lock around switch levers, handles, or lock holes. It weighs 10 oz and is 8¼ in. long.

Industrial Products Co, 2808 N. Fourth St, Philadelphia 33, Pa.

Brakemotor

For shorter length, brakemotor utilizes the motor end bracket as an integral part of the brake. Frame sizes are 203 to 326. Maximum continuous duty torque is from 3 ft-lb in smaller sizes to 50 ft-lb in the larger sizes. (Bulletin 1550)

Louis Allis Co, Milwaukee 7, Wis.

Wall Heater

Radiant electric wall heater incorporates a thermostat and pilot light. Models are rated 750 and 1,250 w, 115 or 230 v, and are UL approved.

ThermoRay Corp, 141 E. 44 St, New York 17, N. Y.

Vapor-Tight Fixture

Vapor-tight, industrial 500-w lighting fixture, Type BOB, is designed to dissipate the heat from the high-wattage lamps. A slot between reflector and body permits convection currents around the glass globe to flow upward and escape. Vertical fins are cast with the body to radiate heat and create convection currents. A 2-piece porcelain mogul screw-base lamp receptacle simplifies wiring.

Pyle-National Co, 1344 N. Kostner Ave, Chicago 51, Ill.

Dry Extinguisher

Dry chemical extinguisher has thumb-button trigger and a claimed 35-ft range. The UL-approved units are available in 6, 12, 20, and 30 lb sizes. These Model L extinguishers have built-in dial to indicate correct weight. (Catalog DC-62254)

Randolph Laboratories, Inc, 8 E. Kinzie St, Chicago, Ill.

Base Radio

Adapter and control unit allows use of Du Mont's two-way mobile radio systems as base stations. The MCA-901-A control unit converts the 25-54 and 144-174 Mc radios from battery to 117 v ac operation.

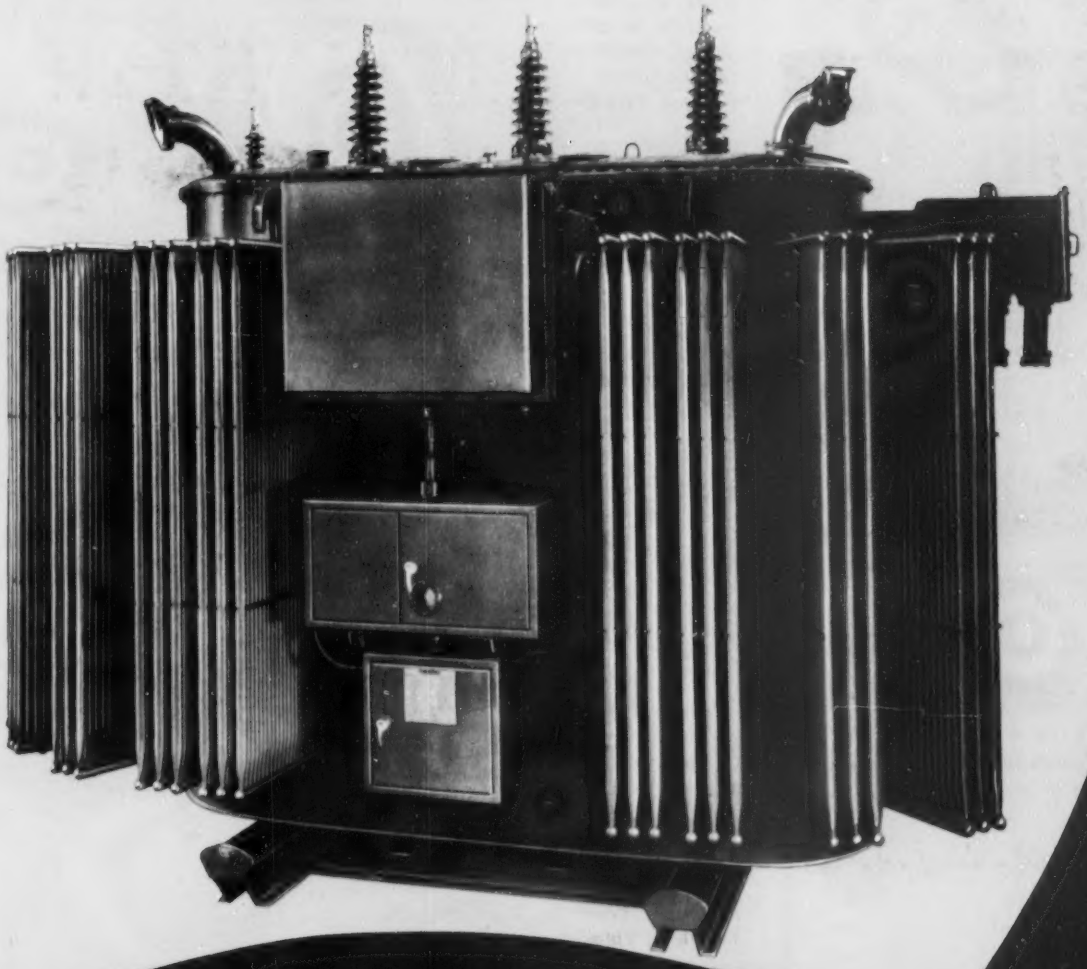
The unit, weighing 10 lb, is equipped with a speaker, volume and squelch controls, and receive-transmit lamp. Many optional features are available. Input is 117 v, 50/60 cps, 75 w standby, 250 w transmit.

Allen B. Du Mont Laboratories, Inc, 1500 Main Ave, Clifton, N. J.

Limit Controller

Limit controller will automatically shut-off the fuel supply at any specified temperature manually set on the indicating scale, and if desired, will sound an alarm. This "700" Series LIMITROL provides insurance against human or instrument failures which may permit overshooting of critical temperatures. The instrument incorporates a thermocouple break protection feature which will shut off fuel

(*Continued on page* 161)



20,000 KVA *three phase* Pennsylvania LOAD RATIO CONTROL Transformer

See next page for inside story

The low voltage windings of this Pennsylvania transformer are provided with tap changing underload equipment for plus and minus 10% regulation in 32 5/8% steps. Self-cooled, the transformer has a rating of 20,000 Kva. However, there are provisions for the future installation of fans to increase the rating to 25,000 Kva. The transformer is designed to step down a transmission voltage of 69,000 volts to 13,200 volts.

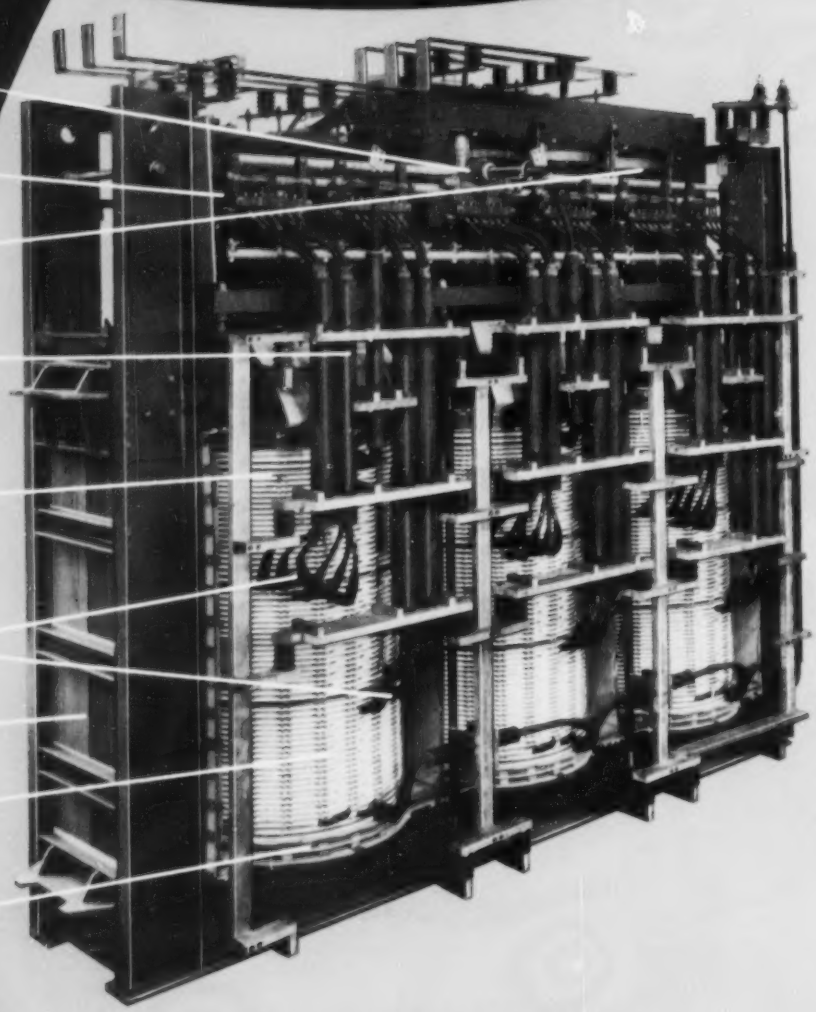
PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division **CANONSBURG, PA.** *Greater Pittsburgh District*

20,000 KVA *three phase* Pennsylvania

LOAD RATIO CONTROL

Transformer



Straight-line, no-load tap changer on high voltage side.

Preventive auto transformer permits uninterrupted current flow during tap changes.

Series transformer reduces current of load ratio control mechanism.

Well-insulated tap leads, rigidly supported in heavy pressboard tubes, are connected to the straight line, no-load tap-changer.

Coils are precompressed with a force equal to the highest short circuit stress and built into the transformer at that compressed dimension. This prevents mechanical distortion of the coils if short circuit stresses occur.

Two sets of taps per coil assure excellent electrical and mechanical balance in the windings.

Five-legged core reduces height of transformer.

Continuous pancake winding in High Voltage coils. Helical winding in Low Voltage coils.

Line ends of coils are heavily insulated to provide extra protection against surge voltage stresses.

20,000 Kva. Three phase, 60 Cycles, 55°C. Temperature rise. High Voltage: 69,000Y volts. Low Voltage: 13,200 Delta volts. Low Voltage windings provided with tap changing underload equipment for plus and minus 10% regulation in 32 5/8% steps.

For exterior view of this transformer, see other side

pt

PENNSYLVANIA TRANSFORMER COMPANY

A McGraw Electric Company Division

CANONSBURG, PA. *Greater Pittsburgh District*

New Equipment

(*Continued from page* 158)

input in the case of thermocouple failure or broken connections.
Wheelco Instruments Div, Barber-Colman Co, Rockford, Ill.

Auxiliary Switch

Auxiliary switch for controlling indicator lamp circuits and interlocking circuits between air-break switches and oil circuit breakers utilizes standard mercury-switch contacts. It is designed for mounting directly on a group-operated air-break switch, rather than on the actuating mechanism, assuring positive lamp indication of the position of the switch blades. Switch is in a weather-proof housing and supplied with 4, 8, or 12 SPST contacts.
Royal Electric Manufacturing Co, 1122 E. 85 St, Chicago 39, Ill.

MORE NEW PRODUCTS
about which you should know

National Alarms Corp, Lafayette, La. has portable **fire-fighting equipment** incorporating a 3,500-w ac Onan generating plant. Versatile Power uses "wet-water" solution for more effectiveness on Class A and B fires.

Quaker Rubber Corp, H. K. Porter Co Inc of Pittsburgh, Philadelphia 24, Pa. has chemical-, oil-, and abrasive-resistant **fire-fighting hose** . . . American-LaFrance-Foamite Corp, Elmira, New York has **proportioner** for drafting 6% Foamite Airfoam and "wetter" water.

Mathias Klein & Sons, 7200 McCormick Rd, Chicago 45, Ill. has KG No. 1 **gaff gauge.**

O. Z. Electrical Manufacturing Co, Inc, 262 Bond St, Brooklyn 17, N. Y. has Type PK armored **cable clamp** for terminating interlocked armored cable, 0.99-4.38-in. OD.

Hays Corp, Michigan City, Ind has miniature **remote indicator** with 5-in. useable scale, electric or pneumatic (Publication 54-1075-223) . . . Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa. has electronic strip chart **recording instrument** with single scale and automatic range extension in five equal suppression steps.

General Electric Co, 1 River Rd, Schenectady 5, N. Y. has:

Dc recording hysteresigraph: Determines the magnetic characteristics of metal by tracing the "gignature" directly onto a scaled chart in a matter of minutes. It has 9 sensitivities with fullscale readings between 2,000 and 1-million interlinkages.

Ignition transformer for oil burners: Replacement type. Electromagnetic and electrostatic shielding. Input, 100-120 v 60 cps; output, 10,000 v, 0.250 kva. Short-circuit current, 23 ma. Weight, 9½ lb.

Fhp gear-motors: Form G, right-angle or concentric-shaft. No slippage. Ratings, ¼, ⅓, ½, and ¾ hp; 115/230 v single-phase and 220/440 v 3-phase. Speeds of right-angle shaft gear motor are 24 to 148 rpm. Speeds for the concentric shaft type are 13.5 to 520 rpm.

Motor-starting relay: Type ARR-1, rated up to 5 hp, 115/230 v. Replaces centrifugal switch for starting single-phase capacitor-start, and capacitor-start capacitor-run fractional- or integral-horsepower motors. Relay coil is wired across the starting winding of a single-phase motor and picks up at a predetermined voltage when the motor comes up to speed.

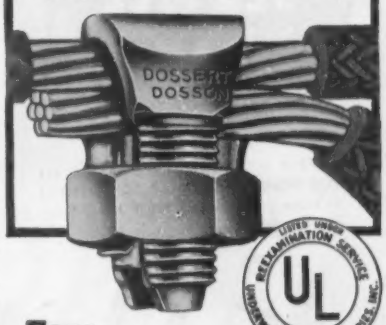
Dawson Corp, 302 Fifth Ave, North Pelham, N. Y. has Model 75 Chromplater **chrome plating unit,** 13 x 13 x 11 in., 110 v 60 cps input.

Holub Industries, Inc, Sycamore, Ill. has Cat. No. Hi-225 **tool** for ripping outer covering of non-metallic sheathed cable, has wire-gauge holes in handle.

Zenith Electric Co, 152 W. Walton St, Chicago 10, Ill. has mechanically held, electrically operated **transfer switch,** automatic or manual, operates in 1/25 sec.

Dow Corning Corp, Midland, Michigan has A-4000 **adhesive** for bonding silicone rubber to itself or to aluminum, magnesium, stainless steel, butyl or saran rubber. It sets up without pressure in 24 hr at room temperature.

NEW!
DOSSON "F"
SPLIT BOLT
CONNECTOR



LISTED UNDER RE-EXAMINATION SERVICE UL UNDERWRITERS' LABORATORIES, INC.

For:
taps, dead-ends, service entrances, motor leads, junction boxes, ground wire-to-neutral connections

Fabricated from high strength alloys, all component parts of the new Dosson "F" Connector are cold formed, insuring consistent uniformity and high quality. Can be used economically over and over again!

Why It's Your Best Bet:

- high clamping pressure insures tight contact
- maximum tightening force: high translation of tightening torque
- connector alloys possess greater physical properties than average steels
- longer bearing pressure bars avoid conductor crushing, load concentration
- smooth edges can't cut lineman's gloves, nick conductors
- withstands high overload, vibration, corrosion

50 YEARS OF TECHNICAL KNOW-HOW

FREE SAMPLE upon request. Write today!

IN STOCK FOR IMMEDIATE DELIVERY

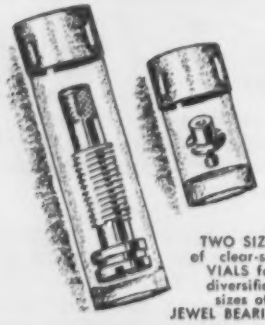
DOSSERT REPRESENTATIVES IN PRINCIPAL CITIES

DOSSERT MFG. CORP.
249 HURON STREET, BROOKLYN 22, N. Y.
SINCE 1904

New

JEWEL BEARING SERVICE PAK

HERE'S MAXIMUM ASSURANCE OF TOP BEARING SURFACE CONDITIONS — when you use these NEW Jewel Bearing Service Paks.



TWO SIZES of clear-sight VIALS for diversified sizes of JEWEL BEARINGS

These clear-vision SERVICE PAKS with the inner VIALS allow immediate checking of quantity available. All possibility of blemishes on the polish, scratches, ruptures, or foreign matter present — is eliminated.

All Eastern Specialty Jewel Bearings are now packed in the complete SERVICE PAK. Maximum protection at minimum cost.

Write for Complete Information

EASTERN SPECIALTY CO.
PHILADELPHIA 40, PA.

TECHNICAL LITERATURE

FILM: THE EAGER MINDS—27-min color film on electrical progress, is released in celebration of the 75th anniversary of Edison's electric light. Movie presents past achievements and future promise of electrical living—from the invention of the light to the solar battery. Produced by R.K.O. Light's Diamond Jubilee Committee, 2650 Graybar Bldg, 420 Lexington Ave, New York 17, N. Y.

FILM: POWER IN PLACE—four color, 16-mm sound, 22 min, shows how modern power transformers are installed. It shows large transformers being installed at the Delta Station of the Mississippi Power & Light Co and at the Oak Creek Station of the Wisconsin Electric Power Co. GE Apparatus Offices, or General Electric Co, 1 River Rd, Schenectady 5, N. Y.

FILM: ALL I NEED IS A CONFERENCE—16 mm, 30 min, has been produced by General Electric Co's Education and Training Services Dept to help train businessmen in the art of leading a conference. Film presents a business problem and its solution through a conference of supervisors. Skills of the conference leader are shown. A training course manual and conference primer accompany film. Price, $165. Henry Strauss and Co, Inc, 668 Fifth Ave, New York 19, N. Y.

ALUMINUM WELDING RODS—Tentative Specifications for Aluminum and Aluminum-Alloy Welding Rods and Bare Electrodes, ASTM B285-54T, AWS A5.10-54T, 10 pages, covers rods for use with gas, carbon-arc, atomic-hydrogen and inert-gas metal-arc (nonconsumable electrode) welding processes, and bare electrodes for use with inert-gas metal arc (consumable electrode) welding process. Price, 25¢. American Welding Society, 33 W. 39th St, New York 18, N. Y. or American Society for Testing Materials, 1916 Race St, Philadelphia 3, Pa.

RESISTANCE WELDING OF COPPER AND COPPER BASE ALLOYS, Bulletin 20, 9 pages, covers various factors entering into the weldability of copper and copper base alloys, as well as technical aspects of the welding processes recommended. Price, 10¢. Resistance Welder Manufacturers' Assn, 1900 Arch St, Philadelphia 3, Pa.

WELDING ELECTRODES—Mild Steel and Low Alloy Arc Welding Electrodes, 32 pages, covers electrodes, application and procedure data, formulae for estimating welding costs, heat treating, hardness conversion tables, and other reference material for the welding engineer, metallurgist, and welding foremen. Metal & Thermit Corp, 100 E. 42 St, New York 17, N. Y.

WROUGHT-ALUMINUM ALLOY DESIGNATION—Alloy Designation System for Wrought Aluminum (Effective Oct. 1, 1954), 4 pages, covers the new system for wrought aluminum and aluminum alloys. The Aluminum Assn, 420 Lexington Ave, New York 17, N. Y.

EXPANDED ACSR — Alcoa Expanded ACSR For "Superhigh" Voltage Transmission, 16 pages, covers conductor for power transmission above 300 kv and the basic research, engineering investigations and tests involved in its development. Erection techniques, accessories, and stress-strain and sag-tension information is included. Aluminum Company of America, Alcoa Bldg, Pittsburgh 19, Pa.

ALUMINUM DATA — Aluminum Data Book, Aluminum Alloys and Mill Products, 220 pages, 1954 edition, covers detailed data on properties and characteristics of aluminum. It covers wrought aluminum alloys, mill products, fabrication, casting alloys and methods, foundry practices; physical, atomic, and radioactive properties; chemical and mechanical properties; tabular data; physical properties; and new alloy designation system. Sent without charge to engineers, instructors, or executives on letterhead request; price to others, $1.00. Reynolds Metals Co, 2500 S. Third St, Louisville 1, Ky.

CATALOGS • BULLETINS

● **HONEYWELL INDEX:** Bulletin 100-C (12 pages) contains a classified index of current literature issued by the Industrial Division, Minneapolis-Honeywell Regulator Co, Wayne & Windrim Ave, Philadelphia 44, Pa.

● **FIELD-OFFICE TRAILERS:** Folder contains brochures on field office trailers and custom mobile units. International Trailer Co, Inc, 5712 Erdman Ave, Baltimore 5, Md.

● **CHAIN DRIVES:** An 8-page catalog (B20-53) describes line of mechanical power transmission products: silent chain, roller chain, Hy-Vo drives, sprockets, cable chains, drive shafts, couplings and clutches. Morse Chain Co, 7601 Central Ave, Detroit 10, Mich.

● **SCALE MODELS:** A 4-page brochure shows typical scale models built by Arthur B. Johnson & Co, Inc, 392 E. 201 St, New York 58, N. Y.

● **INCINERATOR:** Catalog sheet describes Model 4-ESP electric incinerator using 600-w Calrod element. Calcinator Corp, Bay City, Michigan.

● **LIGHT LOUVER:** The Gratelite Story, 8 pages, shows typical installations of a louver-diffuser. Edwin F. Guth Co, 2615 Washington Ave, St. Louis 3, Mo.

● **GERMICIDAL LAMP:** Catalog sheet shows G-918 (15 w) and G-936 (30 w) fixtures for use with an ultra-violet bactericidal lamp. Gruber Lighting, 125 S. First St, Brooklyn 11, N. Y.

● **FARM LIGHTING:** Bulletin 122-54, 4 pages, covers yard and haymow lighting equipment. Steber Manufacturing Co, Broadview, Ill.

● **PLANTS:** A 44-page booklet illustrates recent electrical installations totaling over $85 million made by Patterson-Emerson-Comstock, Inc, 313 E. Carson St, Pittsburgh 19, Pa.

● **ISOLATED PHASE BUS** for Lifetime Reliability and Economy, 15 to 69 kv, 1,200 to 10,000 Amp, a 20 page booklet (B-5906), is available from Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Pa.

● **LUGS:** Condensed Catalog and Price Sheet, May 25, 1954, 4 pages, shows terminal lugs. Jasper Blackburn Corp, 35 Madison St, St. Louis 6, Mo.

● **CAPACITORS:** Bulletin Sheet 156 shows oval, metal-cased ac capacitors, Types KK, KA, KD, KV, 3 to 14 uf, 220 to 850 v, 60 cps. Cornell-Dubilier Electric Corp, South Plainfield, N. J.

● **RESISTORS:** Concentric disc resistors and resistance strips are covered in Bulletin T-1, 4 pages. International Resistance Co, 401 N. Broad St, Philadelphia 8, Pa.

● **CONTROLS:** Two items are covered in a page bulletin. The Flexi-Turn is a turntable with controllable, reversible, variable speed for production or display uses. The Magic Box is a flasher control for "chaser" or "speller" action of electric signs. Gale Dorothea Mechanisms, 81-01 Broadway, Elmhurst, L. I., N. Y.

● **BATTERIES:** Bulletin CP-537 (4 pages, covers Plasticell lead-antimony batteries and CP-536 (4 pages) covers Plastical lead-calcium batteries for control, switchgear and auxiliary power. C&D Batteries, Inc, Washington & Cherry St, Conshohocken, Pa.

● **BATTERY SERVICE:** Engineering Services for Users of Edison-Equipped Industrial Trucks, 4 pages, says that Edison service engineers visit the user periodically for inspection, advice, instruction, and assistance. Edison Storage Battery Div, Thomas A. Edison Inc, West Orange, N. J.

BOOKS

Engineering's Background

History of the Theories of Aether and Electricity. **By Sir Edmund Whittaker. Published by Philosophical Library, Inc, New York 16, N. Y. 328 pages. Price $8.75.**

Today's engineering problems and methods derive from physical research of the past. But so precipitous have been recent advances that few engineers pause to evaluate their beginnings. Essential tools of today's technology — Relativity, Quantum Theory, Matrix Mechanics, and Wave Machanics—all have been developed since 1896 when Becquerel discovered the radio-activity of uranium.

The engineering profession has a place for statesmen who, by their scholarly command of its history, impart meaning and directivity to its advances. To such readers this book offers valuable assistance.

Historical Backgrounds

Ten Founding Fathers of the Electrical Science. **By Bern Dibner. Published by The Burndy Library, Norwalk, Conn. 48 pages, illustrated, board covers. Price $1.00**

Latest in the Burndy Library series about the history of science and technology, this volume presents brief bibliographical sketches of the ten early scientists whose researches enabled today's electrical living. Each sketch is beautifully illustrated with a portrait of the subject and a sketch relating to his contribution. And the whole is produced in the fascinating style which has characterized previous volumes of the series.

Dibner's selections includes Gilbert and von Guericke for early investigations in the 17th century. Franklin alone represents 18th century advances. The 19th century is marked by the many contributions of Volta, Ampere, Ohm, Gauss, Faraday, Henry, and Maxwell. In his scholarly digest of the advances of these ten, the author skillfully presents the history of electrical science. His book is a worthy addition to every engineer's personal library.

GUY-GRIPS COST LESS

per pound of tensile strength
per year of service life . . . .

PREFORMED "GUY-GRIPS" are the fastest, most economical and most efficient means of dead-ending guys. They eliminate the need for clamps and ARE INSTALLED BY HAND. Since they cannot slip whether they are dead-ending a 2,000-pound, solid-wire guy or a 10,000-pound, ⅝" EHS steel guy, no retightening is ever necessary.

One large Utility has found that Preformed "Guy-Grips" save 50% on labor and 20% on material. Another assembles and installs a complete Preformed Guy Assembly (4 dead-ends) in the same time it used to take to assemble just one 3-bolt clamp.

PREFORMED "GUY-GRIPS" are proving definitely throughout the Country that they assure:

Maximum Corrosion Life — *Maximum Installed Tensile Strength*
Maximum Fatigue Characteristics — *Maximum Impact Strength*
Maximum Neatness in Appearance

Available in aluminum, copper, bronze (various grades including calsun), copperweld, stainless steel and galvanized steel, PREFORMED "GUY-GRIPS" assure the longest satisfactory guy life.

For complete details of their exclusive advantages, write, or telephone Cleveland: EXpress 1-3571.

PREFORMED LINE PRODUCTS CO.
5349 ST. CLAIR AVE. • CLEVELAND 3, OHIO

LETTERS TO THE EDITOR

Industry Puts OK on 'It's a Grass Roots Job'

Human Nature Being What It Is

To the Editor:

Re: "It's a Grass Roots Job"

The story needs telling, re-telling, and telling again.

Someday we may profit by the lessons that can be learned by studying the cooperative endeavors of bees, or even the lowly ants.

However, you know full well that it will take a lot of telling to persuade man to forego any part of his ego in the interest of the greater good that can only be obtained through cooperative endeavor.

Carl H. Christine
Secretary-Manager

St. Louis Electrical Board of Trade
1221 Locust Street
St. Louis 3, Mo.

A Pat on the Back For a Utility

To the Editor:

Please accept my congratulations for your June 28 editorial, "It's a Grass Roots Job." It certain points up a situation which needs attention from every division of the electrical industry.

Having enjoyed the closest sort of cooperation of our utility, the San Diego Gas & Electric Co, since the inception of the bureau 22 years ago, we are most conscious of the help utilities everywhere could give if they were so minded. You are so right. Instead of having 65 electric leagues, we should have several hundred throughout the United States.

J. Clark Chamberlain
Secretary-Manager

Bureau of Home Appliances of San Diego County
525 E St.—Room 222
San Diego 1, Calif.

EW Blesses All Who Believe

To the Editor:

Blessed are they who have not seen your June 28 editorial yet believe in their electrical league.

It's hard for me to understand how any utility man could read your words of sound wisdom and not do something about it, if he hasn't a league organized. It's hard—unless his heart isn't in his job, and he doesn't really believe that electricity is here to stay.

More power to you!

Patrick E. McCaughey
Product Manager-Stab-lok

Federal Electric Products Co and
Pacific Electric Manufacturing Corp
50 Paris Street
Newark 5, N. J.

• Many of the additional letters on the thought-provoking editorial which have been received by the editor will appear in following issues.

Editorial Suggestion Brings Dismay

(*See Lead Editorial on page 59*)

To the Editor:

We were greatly dismayed to note your editorial in the July 26 issue (p 72) concerning a proposed supplementary air raid alarm. If you will inquire among people responsible for power system operations, you will find the device in question, which could be designed to operate either by increasing the power system frequency to perhaps 62 cycles or decreasing it to 58 cycles, is wholly impractical.

In power system operation frequency control is usually considered the most important factor. Voltages may be decreased temporarily or load may be decreased by opening circuits, but frequency is always maintained very close to 60 cycles. Variations would interfere with the operation of textile machinery, electronic equipment such as X-ray machines, radio and TV stations and receivers, and many other operations, causing untold damage.

With the extensive interconnections which exist today, extending across hundreds of miles and in some cases including up to 20 million kw of capacity, it would be impossible to change the frequency from normal without extensive switching operations to isclate the individual systems. Even then, it would be nearly impossible to regulate the generation stations and produce the desired change. It would take hours to perform those operations.

Our interconnections are important under normal circumstances but are of utmost value in times of distress. It is unthinkable that anyone would even consider imposing the proposed handicaps.

This proposed device was brought to the attention of EEI about a year ago. The Federal Civil Defense officials were advised last October that, while the power industry most sincerely desires to cooperate in Civil Defense activities, this particular device was completely impractical. Additional information was submitted in April of this year.

We are at a loss to understand why valuable time and effort are being devoted to it. We trust that Electrical World will undertake to rectify the impression conveyed by its editorial.

A. S. Griswold, Chairman
Electric Power Survey Committee
P. B. Metcalf, Chairman
Subcommittee on Continuity of Service Protection

Edison Electric Institute
420 Lexington Avenue
New York 17, New York

Penelec's first 230-kv line

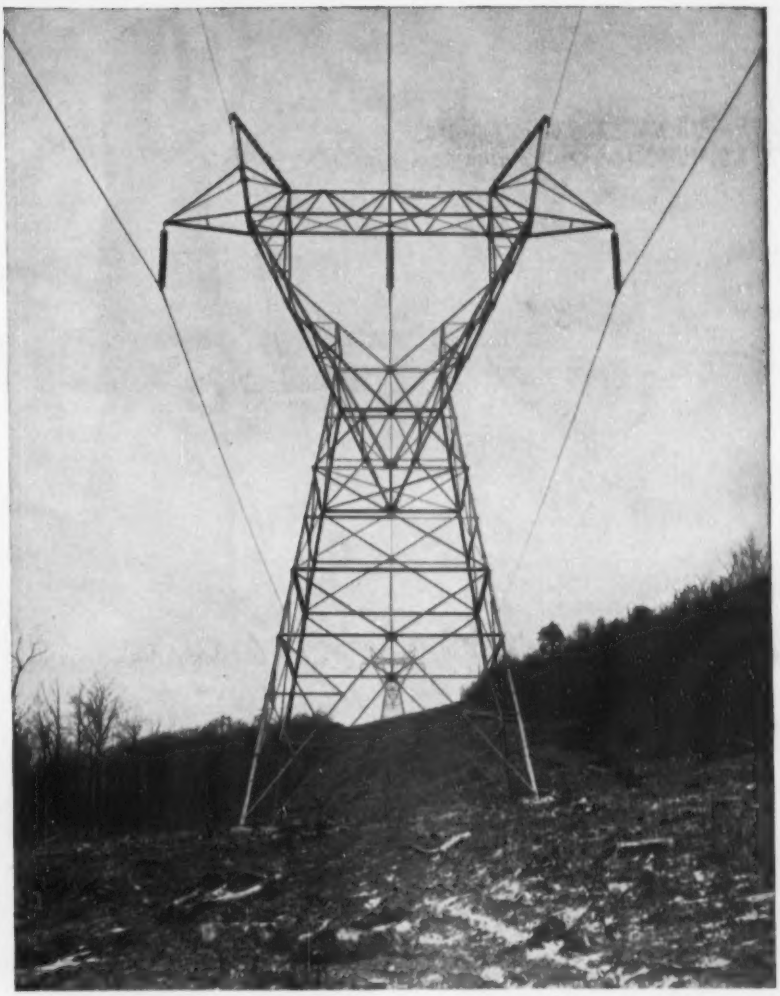
87-mile transmission line carries Shawville power over rugged Allegheny terrain

Many months of rugged field work were rewarded when Pennsylvania Electric Company's first 230-kv line was energized early in February of this year. The line feeds power from Penelec's big Shawville steam generating plant, brand new in 1954, to the Lewistown substation, and ties in with Metropolitan Edison's 230-kv line at Montebello, about 15 miles northwest of Harrisburg.

ROUGH ROUTE . . . Between Shawville and Montebello lie 87 miles of typical central Pennsylvania real estate — as pretty as can be if you're sightseeing, but downright nasty if you're trying to construct a transmission line. Some of the highest and unfriendliest mountains in the East angle through that country from northeast to southwest, including the Allegheny Range and most of the Appalachians. The job of the line builders was to cut straight across the mountains from the northwest to southeast. The result is a line with hardly a level stretch.

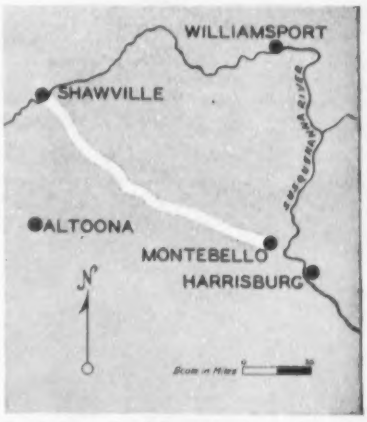
SINGLE-CIRCUIT TOWERS . . . The line consists of 430 single-circuit Bethlehem towers of suspension, angle and dead-end types, each approximately 90 ft high. Normal tangent length is 1100 ft, although some spans are more than twice that long. As shown by the picture, variable leg extensions were a "must" in covering the rough and hilly terrain.

SEVERE ICE CONDITIONS . . . Because heavy ice and sleet conditions are common in this area, Penelec specified that the towers withstand double the normal ice loading. As designed by Bethlehem engineers, the conductors are able to handle a 1-in. rather than ½-in. ice loading, and can take a heavy-ice-loading tension of 30,600 lb, compared with the NESC heavy loading at 12,000-lb tension. These and other unusual precautions are expected to reduce interruptions to a minimum regardless of the weather.



Suspension towers equipped with leg extensions climbing a steep hillside near Lewistown, Pa.

FABRICATED IN LEETSDALE, PA. . . . Tower steel for the Penelec line was fabricated, galvanized and detailed at Bethlehem's fabricating works in Leetsdale, Pa., near Pittsburgh. Other Bethlehem tower-fabricating works are located in South San Francisco, Calif., and Seattle, Wash. If you would like to have information about Bethlehem's design and fabrication of transmission towers, please call the nearest Bethlehem sales office.



Penelec's new line follows a southeasterly course for 87 miles, beginning at Shawville on the west branch of the Susquehanna River, and terminating at Montebello.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation
Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

One
This one

company

One company launched the aluminum industry.

One company has 66 years of aluminum research and production experience.

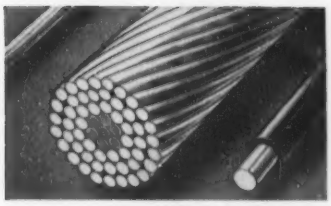
One company has 56 years of technical and field experience with aluminum conductors.

One company maintains the outstanding research, development, testing and production facilities in aluminum conductors.

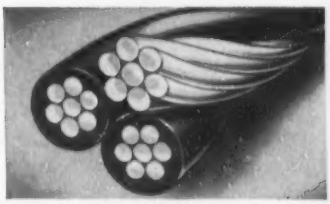
One company has developed and improved aluminum conductor alloys and aluminum conductor designs.

One company manufactures and stands behind a dependable line of both aluminum electrical conductors and accessories.

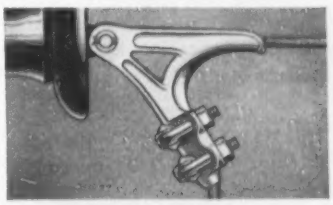
One company maintains a complete headquarters and field engineering staff to assist those who transmit and distribute electric energy.



ACSR and All-aluminum Wire and Cable



Covered Wire and Service Drop



Accessories for All Conductors

company is ALCOA

ALCOA ALUMINUM

ALUMINUM COMPANY OF AMERICA

Wilson Appointed President...

. . . of Mississippi Power & Light to succeed Rex I. Brown, newly elected chairman of the board of directors

R. BAXTER WILSON

R. Baxter Wilson, vice president of Mississippi Power & Light Co, has been elected president of the utility to succeed Rex I. Brown, newly appointed board chairman.

With MP&L 27 Years . . . Wilson's promotion to the presidency comes after about 27 years of service to the company. He started with Mississippi P&L in 1926 as a groundman. After receiving his degree in engineering from the University of Mississippi in 1927, he became local manager at Edwards. In 1928 he was named manager at Cleveland, and ten years later was named division manager of the Northern Division with headquarters at Cleveland.

He went in 1941 to the company's general offices at Jackson as assistant operating manager. He was made assistant general manager in 1943 and elected vice president in 1946. He was named a director of the utility a year later.

REX I. BROWN

Utility Veteran . . . Brown became affiliated with Mississippi P&L in 1932 as vice president and general manager, assuming the presidency four years later. Prior to starting his career with the Mississippi company, he was identified with the utility industry in Little Rock, Ark., for more than 20 years.

Richard D. Carter has been appointed supervisor of information services for Westinghouse Electric Corp's Steam Division, near Lester, Pa. Associated with Westinghouse since 1949, Carter formerly worked in the public relations department of the company's Electric Appliance Division in Mansfield, Ohio.

J. C. Conder has been made superintendent of Utah Power & Light Co's Carbon Plant at Castle Gate. The utility also named J. M. Smith assistant superintenent of the plant. Associated with the company since 1939, Conder has been serving since 1953 as results engineer at Utah P&L's Hale Plant at Orem. Since joining Utah P&L in 1951, Smith has served them as junior engineer and associate engineer.

E. L. Huse, formerly Northern Division power engineer for Jersey Central Power & Light Co, has been designated division sales manager. Huse, who started with the utility in 1935 as a lighting engineer, will work out of the company's commercial office in Morristown, N. J.

Georgia Power Co Makes Engineering Staff Changes

Georgia Power Co has announced that L. B. Locklin, superintendent of production, and A. B. Greene, Jr. superintendent of generating plant construction will assume the duties formerly carried out by B. W. Sinclair, who retired last month as manager of production.

Locklin will have general charge of the operation and maintenance of all power plants in the Georgia Power system and Greene will superintend the construction of all generating plants, transmission lines and substations.

In other appointments, R. S. Causey was made assistant superintendent of production and W. S. Bradley assistant superintendent of construction. J. T. Hanie, field engineer in the line construction section, was advanced to field supervisor of all construction projects.

Sinclair, for whom Sinclair Dam is named, retired after more than 42 years' service with the utility.

RALPH R. BUTLER

Named Executive VP

Unistrut Products Co, Chicago has appointed Ralph R. Butler to the post of executive vice president. Prior to this appointment, he was vice president of Unistrut Eastern Sales Division. He has served Unistrut Products for nine years, interrupted by four years' service with the Navy as a lieutenant commander.

Crapo
GALVANIZED STEEL
STRAND

Strong... to support pole structures under adverse ice and wind loadings.

Rugged... to withstand the punishment incurred in construction and service.

Long-Life... provided by famous *Crapo* Galvanized heavy, ductile, tightly-bonded zinc coatings.

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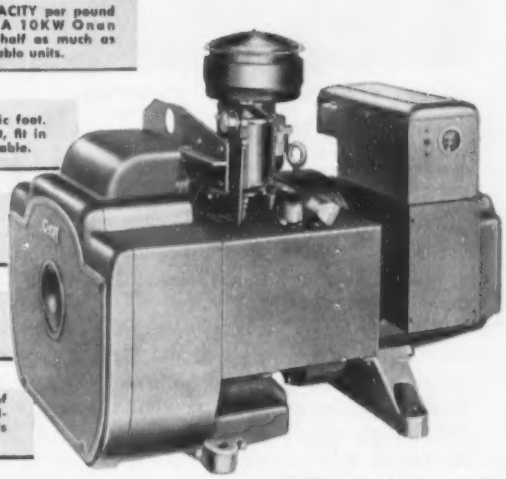

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. . . yet kilowatt for kilowatt, an ONAN costs you less than any other electric plant!

ONAN gives you many advances in electric plant design, plus proved dependability on the job! You pay no premium for these Onan features . . . in fact all the electric plants shown here are priced lower than other plants of similar capacity.

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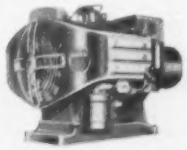
DIESEL: Air-cooled—3,000 and 5,000 watts. Water-cooled—15,000 to 55,000 watts.

MODEL 30SCK—3½KW A.C. 2-cyl. air-cooled, gasoline engine.



MODEL 5DRP—5KW A.C. Diesel two-cylinder air-cooled.

MODEL 3DSP—3KW A.C. Diesel one-cylinder air-cooled.

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Electrical World Reveals Staff Changes

Electrical World has announced several top level business and editorial appointments.

Two McGraw-Hill employees are among the new members of the magazine's New York staff. Warren W. Shew, formerly of McGraw-Hill's Philadelphia office, has been appointed advertising sales manager. He took over his duties Sept. 1.

The other is Jesse Mock, who will be assistant to the editor of Electrical World. Mock will start working in New York on Sept. 15 after having served for several years in McGraw-Hill's Washington office.

New Associate Editors . . . Electrical World's newly appointed associate editors are Rue Shoop and George Swift. Shoop, formerly Middle Eastern editor, will be in charge of EW's manufacturing and markets section.

Two newly assigned regional editors of Electrical World are David Rea and John J. Kearney, Jr. Rea, an assistant editor of EW, will serve as Northeastern editor. Kearney, a former employee of Ebasco Services, Inc, will be Middle Eastern editor.

E. B. Sessions comes to Electrical World as assistant editor following several years employment with Utah Power & Light Co's public relations department. He was editor of the utility's house organ for a year. Clayton Cool is now serving as an editorial assistant with EW. Prior to joining EW this year, Cool spent a year with the McGraw-Hill Book Co's Technical Writing Service as an assistant engineer. His experience includes radar and microwave operation, design, manufacture, and service.

Shew . . . The background of the new adveritsing sales manager includes employment with General Electric Co first as an electrical design engineer and later as a sales engineer. Shew, a graduate of Pennsylvania State College in electrical engineering, joined McGraw-Hill in 1947 as an advertising salesman for "Electronics."

Mock . . . He started reporting the news and writing Washington Comment in the nation's capital for Electrical World in 1951. He covered Washington for four years as a correspondent for a number of out-of-town newspapers prior to his affiliation with McGraw-Hill.

Shoop . . . An electrical engineering graduate of Pennsylvania State College, he has long and diversified experience in the electrical industry. Formerly with Bethlehem Steel Corp and General Electric, he acquired knowledge of testing and industrial engineering, industrial control and machine tool applications, and served as a sales engineer. Since his association with EW in 1941, he has been an assistant editor of the "Standard Handbook for Electrical Engineers".

Swift . . . His nine-year tenure with Consolidated Edison Co of New York, Inc, included five years with the Test Bureau and four years in the Service-Maintenance Department. Swift, a newspaperman for 10 years, came to EW in January from McGraw-Hill's Technical Writing Service.

Rea . . . He was a distribution engineer for Seattle (Wash.) City Light after getting his B.S. degree in electrical engineering from the University of Washington. He joined the staff in 1952 after developing and testing engine generators and their control systems for two years in the Signal Corps Engineering Laboratories.

Kearney . . . While with Ebasco Services, he worked on preparation of specifications for power plant equipment and supervising plant design. Kearney, an electrical engineering graduate of Notre Dame University, has widened his knowledge of power plant practice by many field trips to supervise utility installations.

JOHN J. KEARNEY

DAVID REA

E. B. SESSIONS

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reduces costs of

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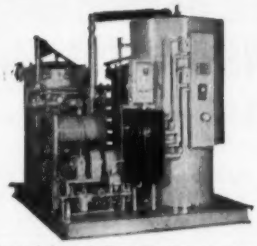
With this 300 g.p.h. mobile Hilco Reclaimer the City of Tacoma, Washington, purified 100,000 gallons in three months at a saving of $20,000.



Cincinnati Gas & Electric Company reports an annual saving of $4,000 with this stationary Hilco Reclaimer.

The HILCO HYFLOW Oil Reclaimer combines a duplex fullers earth filter with a vacuum vaporization system to remove water, sludge, soluble oil oxidation products, paint, bushing compound, metallic soaps, etc. Oil is restored to new oil values as indicated by Neutralization Number, Interfacial Tension, and other tests.

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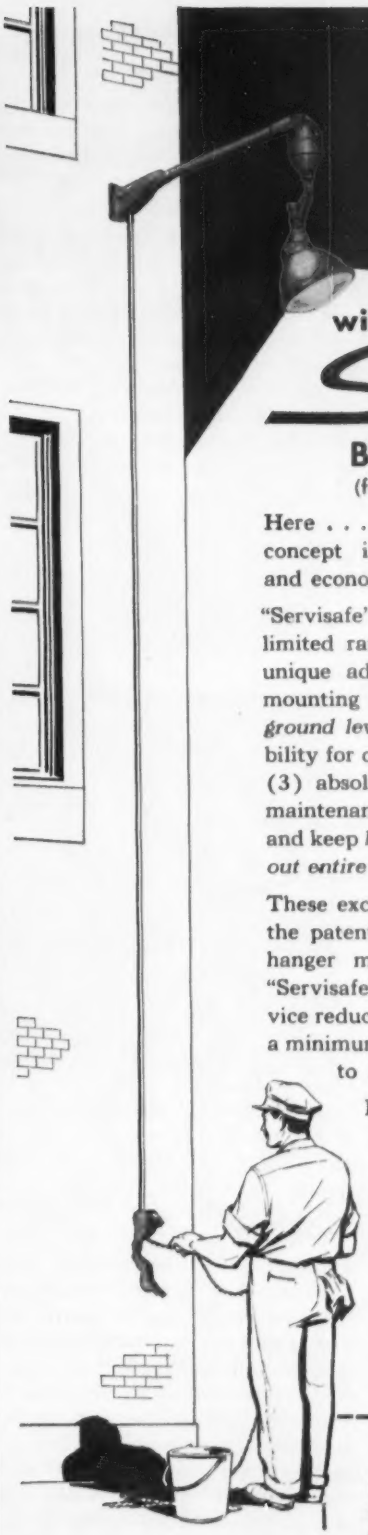
with THOMPSON *Servisafe* BRACKET UNITS

(for walls and wood poles)



Here . . . ready-to-install . . . is a new concept in outdoor lighting efficiency and economy.

"Servisafe" Bracket Units combine an unlimited range of applications with these unique advantages . . . (1) luminaire mounting heights up to *60 feet above ground level* . . . (2) all-weather accessibility for quick luminaire maintenance . . . (3) absolute safety is provided because maintenance men work on a dead fixture and keep *both feet on the ground throughout entire servicing operation.*

These exclusive features are provided by the patented disconnecting and lowering hanger mechanism incorporated in all "Servisafe" Units. Easy to operate, this device reduces servicing time and hazards to a minimum . . . permits unskilled workmen to handle luminaire maintenance.

Designed for new installations and the rapid conversion of existing facilities, "Servisafe" Bracket Units can be used with all standard pendant and flood type lighting fixtures.

WRITE FOR BULLETIN WPH-54 FOR ADDITIONAL DATA.

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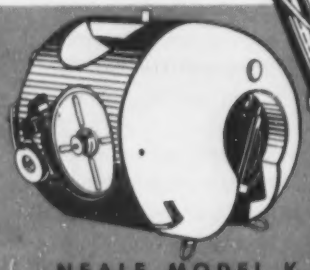

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Supercritical-Pressure

(Continued from page 84)

with a wide range of water level by reducing the hydraulic gradient effect caused by endwise flow of the circulating water in the upper drum.

With the experience at Twin Branch and also at Diamond Alkali with a 2,200-psi, 300,000-lb-per-hr unit beginning in 1939, more than 100 large natural-circulation units were built or are being built for pressures from 1,700 to 2,700 psi.

Data in Fig. 5, illustrating the effect of pressure on circulation, are the results of tests at Twin Branch, Diamond Alkali and Alliance Research Center. The curve shows that a pressure of about 2,700 to 2,800 psi is the practical limit for either natural or forced circulation of the type depending on separation of steam and water. For higher pressures, a once-through steam generator is required.

Need for Supercritical Units . . . Research on supercritical-pressure operation was stepped up about 1948. Advances in metallurgy augured that temperatures of 1,100 F and higher would soon be feasible.

Heat rate studies for various cycle combinations, illustrated in Fig. 6, show the effect on the net overall plant heat rate of increasing the pressure for various temperature levels with one or two stages of reheating. These curves illustrate why increases in pressure must have corresponding increases in temperature if a worthwhile improvement in efficiency is to be obtained. At a temperature level of 1,050 F, it will be noted, there is very little gain from increasing the pressure much above 3,000 psi.

When temperature is increased to 1,200 F, and particularly when a second stage of reheating is added, pressure can be increased profitably to 5,000 psi or higher. The overall net heat rate of the best subcritical-pressure unit now building is in the order of 8,800 Btu per kwhr. This can be reduced to 8,100 Btu per net kwhr by increasing the pressure to 4,500 psi and the temperature to 1,200 F with two stages of reheating. About half of this improvement is due to the increased temperature and the additional stage of reheating, and the other half to the increased pressure. Saving 700 Btu per net kwhr can mean a saving of $13 per installed kw, at today's fuel cost.

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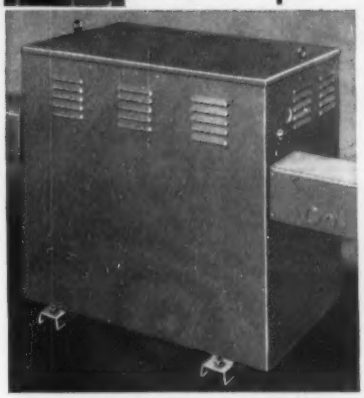
MARCUS dry type TRANSFORMERS ...power this "Electronic Brain"



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As the power source of Remington Rand's famous *UNIVAC* (Universal Automatic Computer), MARCUS TRANSFORMERS perform their valuable function within this Electronic Brain.

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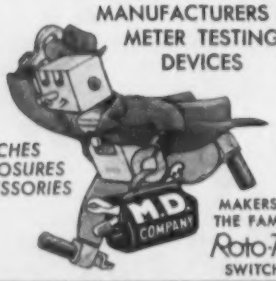

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British Columbia Project on Homathko Planned

Backed by United States and eastern Canadian banking interests, a $150-million hydroelectric development looms as the latest addition to the Northland's mushrooming industrial empire.

The project headed by Waddington Mining Corp, Ltd, in Vancouver, B. C., would involve damming the Homathko River at the head of Bute Inlet, 140 miles north of Vancouver.

Eastern backers were scheduled last week to post a $2-million performance bond required by the British Columbia government to protect the public interest.

Initial plan for the project, which includes a smelter at Waddington Harbor, is to develop 500,000 hp in Homathko-Tatlayoko drainage basin, one of the few remaining large undeveloped power sites on the coast.

Plans, similar to the Frobisher development, call for treatment of ores and concentrate at the smelter and metal industries proposed for the Waddington Harbor site.

A series of dams and generating stations from Tatlayoko Lake to the mouth of the Homathko River would provide the power. Generating stations would be situated about 150 miles west of Williams Lake and about 135 miles from Lillooet.

Waddington has carried out preliminary engineering surveys of the area.

Seattle to Open Bids on Gorge Dam Oct. 6

Bids for construction of the $17-million Gorge High Dam have been called by the Seattle, Wash., Board of Public Works, for opening Oct. 6.

The structure, a combination arch and gravity type dam, will replace a temporary diversion dam on the Skagit River above the Gorge powerhouse and increase its power output. It will rise 150 ft above the river bed.

Project will include about $2 million for highway and bridge construction to provide access to the site.

The City Council has been asked to appropriate another $2.7 million from a surplus in the City Light construction fund to complete another Skagit River project; the in-

stallation of generators in the Ross Dam power plant. It appropriated $51 million in 1947 for construction of the plant, including three 90,000-kw generators. However, costs were increased by an "accelerated program" requested by the Defense Electric Power Administration in 1951, said Paul J. Raver, City Light superintendent.

Co-op Cancels Orders for Rural Electric Paper

San Isabel Electric Association, Inc, has cancelled the subscriptions of its 1,200 members to the "Colorado Rural Electric News" in a policy dispute.

The "News" is published by the Colorado Association of Rural Electric Cooperatives. The state association claims 63,000 members.

Directors of the San Isabel association cancelled the subscriptions after charging state co-op paper is "constantly in the position of being against private utilities and the profit system."

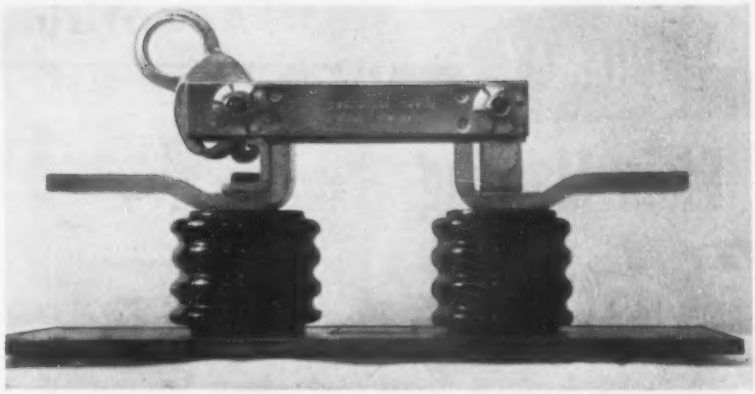
Subscriptions to the newspaper are paid for by the associations and it is sent free to their general memberships.

Grand Canyon to Get Arizona PS Service

Grand Canyon will be added to Arizona Public Service Co's service area as soon as construction of transmission lines and substations is completed.

Contracts were signed by the National Park Service, Fred Harvey, and Arizona Public Service to permit the company to take over all electric distribution. The 200 customers in the area formerly were served by a local generating plant owned by the Santa Fe Railroad. The local power plant will now be maintained on a standby basis for use during any emergencies.

Crews are at work clearing right-of-way for a 60-mile transmission line from the company's substation at Williams, Ariz., to the Canyon. Other construction will include a substation at the Grand Canyon, two substations at the airport and Red Lake, and additional switching facilities at the Williams substation.



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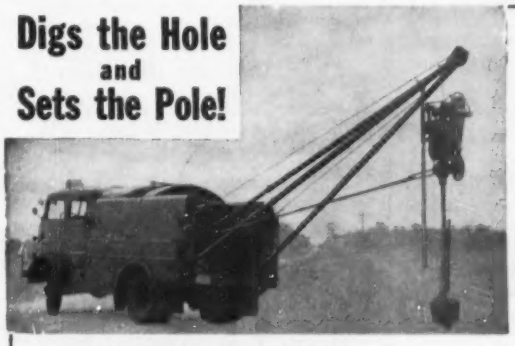

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(Continued from page 177)

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We are looking for a man between the ages of 33 and 38 who has had a college education in engineering, economics, or accounting and has had experience in electric, gas, water or telephone utilities—preferably in rates, engineering economics, business research, or finance.

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for expanding line of competitively priced, high quality, Aluminum Alloy Cable Fittings and Accessories. We have still open many good territories offering excellent financial return to energetic and well qualified men or organizations who are handling associated lines. All replies will be kept in confidence.

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WANTED: YOUNG, graduate power engineers for utility office and field positions. Contact Electrical Engineer, Central Illinois Public Service Company, Springfield, Illinois.

DISTRIBUTION ENGINEER—Two competent experienced graduate Electrical Engineers, with approximately 10 years experience design, operation and maintenance of distribution facilities in established rapidly growing utility located South America. Reply giving resume education, experience and personal data. P-3816, Electrical World.

POSITIONS VACANT

METER SUPERINTENDENT — Established rapidly growing utility in Brazil requires competent technician with 10 years experience Meter Department of U. S. or large Latin American Public Utility to supervise Meter Departments several operating companies. Single man preferred as considerable traveling involved. Reply giving resume education, experience and personal data. P-3817, Electrical World.

LOAD DISPATCHER — Established growing utility in one of most desirable locations in Brazil desires temporary services (about one year) of experienced technician to initiate dispatching service and train local personnel in its operation and maintenance. System is combination thermal and hydro with transmission up to 132 KV. Excellent opportunity for active retired experienced chief load dispatcher. Reply giving education, experienced and personal particulars. P-3818, Electrical World.

ELECTRICAL ENGINEER — Junior or Assistant Distribution Engineer — technical graduate with at least 3 years field experience operating utility Company. Permanent position with long established consulting organization New York. Some travel Latin American necessary in future. Knowledge of Spanish or Portuguese useful. Salary commensurate with experience. Reply stating age, education, experience and personal particulars. P-3819, Electrical World.

ELECTRICAL ENGINEER—Technical graduate—at least 5 years experience on electrical maintenance and operating problems of generating stations and substations of public utility companies. Permanent position with long established consulting organization New York. Some travel Latin America. Spanish or Portuguese useful. Salary commensurate with experience. Reply stating age, education, experience and personal particulars. P-3820, Electrical World.

CHIEF OPERATOR—Power System Analyzer. Desire experienced man with Power System Engineering background. Must be capable of supervising all types of System studies. Also must function in advisory capacity to clients. Age: 35-45 years. Salary: commensurate with previous experience. Middle eastern area. State educational background and experience in letter of application. Write to P-3774, Electrical World.

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POSITIONS WANTED

SALES ENGINEER, B.S. & E.E., 30, married, 5 years experience contacting utilities, industrials for switchgear, transformers, rotating machinery, equipments for transmission and distribution. Desires sales or allied position with future East or Midwest. PW-3780, Electrical World.

EE GRAD, 6 years experience in Electrical design and maintenance desires position with future in South. Age 30—married. PW-3758, Electrical World.

ELECTRICAL ENGINEER, age 36, 15 years design & specifications commercial, industrial and chemical. Familiar all phases of electrical construction industry. Capable assuming complete charge. Impressive record of completed projects. Desire position with AAA firm or willing to free-lance on part time basis. Any phase considered, drawings, specifications, surveys and/or estimates. Willing to travel. PW-3762, Electrical World.

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Transactions A.I.E.E. back-volumes wanted to buy for cash. Ashley 24 E. 21, N.Y.C. (10).

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1136	Fairbanks Morse	38D	1600	720	350	Baldwin	VO-6	510	450
1100	General Motors	16-278A	1600	720	320	Enterprise	DSG-6	560	450
1000	General Motors	16-567B	1440	720	300	General Motors	8-268A	450	1200
750	General Motors	12-567	1080	720	200	General Motors	6-268A	350	900
700	Worthington	EE-8	1000	327	150	Worthington	CC-4	225	450
600	General Motors	8-278A	750	720	150	Ingersoll-Rand	S-4	225	600
500	General Motors	8-567	720	720	150	Buckeye	80	240	600
500	Alco	6-124x13T	750	600	100	General Motors	3-268A	150	1200
400	Sterling	VDS-8	600	1200	60	General Motors	6-71	90	1200

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2— 750 KVA G.E., 1 Ph., 4600V., 115/230
2— 400 KVA Pitts., 1 Ph., 2400/4800/4150/2400—240/480V.
1— 750 KVA—Auto 3/4150—2400
2— 300 KVA G.E., 1 Ph., 13200V., 220/440V.
1— 200 KVA G.E., 3 Ph., 2400-220 sec.
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1— 150 KW G.E., 125/250V., 1200 RPM, 2300 Syn.
1— 100 KW G.E., 250V, 900 RPM, 2300 V. Syn.

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2— 500 H.P., G.E., M 1200 RPM 2400V.
1— 400 H.P., West. CW, 450 RPM, 550V.
1— 250 H.P., West., CW, 600 RPM, 440V.
1— 200 H.P., West., CW, 600 RPM, 440V.
3— 150 H.P., Al. Ch. 1800 RPM, 2300V., 3PH, 60 Cy.
Large Stock of A.C. and D.C. Equipment

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FOR SALE

6—1000 KVA Mol 11500-2400/4160Y
3— 833 KVA G-E 35000—480
3— 500 KVA G-E 26400—240/480
8— 333 KVA W-H 38000-7200/12470Y
3— 333 KVA G-E 33000-2300/4000Y/6900/-11950Y
3— 333 KVA G-E 33000-2300/4000Y
3— 333 KVA Mol 7200/12470Y-2500/4160Y
3— 333 KVA W-H 6600-2300
3— 150 KVA G-E 19050/33000Y-2540/4000Y
5— 150 KVA G-E 7200/12470Y-240/480
3— 100 KVA G-E 33000-6900/11950Y
3— 100 KVA G-E 4000-115/230

Many other items in stock

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Reliable rewind and repair service on all makes of transformers

THE ELECTRIC SERVICE CO.
Cincinnati 27, Ohio
40 Years Dependable Service

250 HP, GE open motor, enclosed slip rings, 300 RPM, stub shaft, 2200 volt.
240 HP ,GE Synchronous motor, direct connected exciter, 600 RPM, 2200 volt.
2—150 KVA. GE Transformers, Type H. Form KW, 11500—230/460 volts, 5 & 10% Taps.
ZIMMERMAN ELECTRIC MACHINERY CO.
1815 E. Central Wichita, Kansas

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GUARANTEED
ELECTRIC POWER EQUIPMENT
MOTOR GENERATOR SETS
3 ph., 60 cy.

Qu.	KW	Make	Speed	DC Volts	DC Volts
1	—3000 3U	G.E.	514	600	4000/13200
2	—2000/2400	G.E.	450	250/300-	2300/4600
2	—2000	G.E.	514	600	6600/13200
1	—2000	G.E.	500	666 25 cy.	11000
2	—2000	G.E.	450	600	2300/4600
1	—1500	C.W.	514	115	4000/13800
1	—1500	G.E.	720	600	13200
1	—1000	G.E.	900	260	4100/6900
2	—1000	Whse.	900	600	2300/4150
3	—1000	G.E.	720	600	2300/4600
1	—750	Whse.	900	275	2300/4150
1	—500	Whse.	1200	125/250	2300
1	—500	Whse.	900	250	440
1	—500	G.E.	720	125	2300

TURBO GENERATORS

Qu.	KW	Make	Desc.
1	—4000	G.E.	Condensing—425 lbs—750° F.T.T.—Surface Condenser 3/60/2300-4000 v with exciter
1	—1000	G.E.	Non-Cond—190 lbs-2400-3-60
1	—1000	Moore	Condensing—Extraction—190 lbs., 2400-3-60—Surface Cond. Condensing—265 lbs., 440-3-60 Built 1944
1	—750	G.E.	Non-Cond—150/200 lbs., 5/35 lbs. B.P., 480-3-60 Dir. Conn. Exciter.
1	—500	Moore	Non-Cond—150/175 lbs., 5/10 lbs. B. P., 480-3-60
1	—300	G.E.	

FREQUENCY CHANGERS

Qu.	Kva	Make	Cycles	Voltages
1	—13900	Whse.	60/25	13200 x 13200
1	—3750	G.E.	60/25	4150/2400 x 2400/4150
1	—3125	G.E.	25/60	4150/2400 x 2400/4150
2	—2500	G.E.	25/62½	2300 x 4160
1	—1250	G.E.	25/58.3	4400 x 2300
1	—625	A.C.	25/60	11000 x 2300

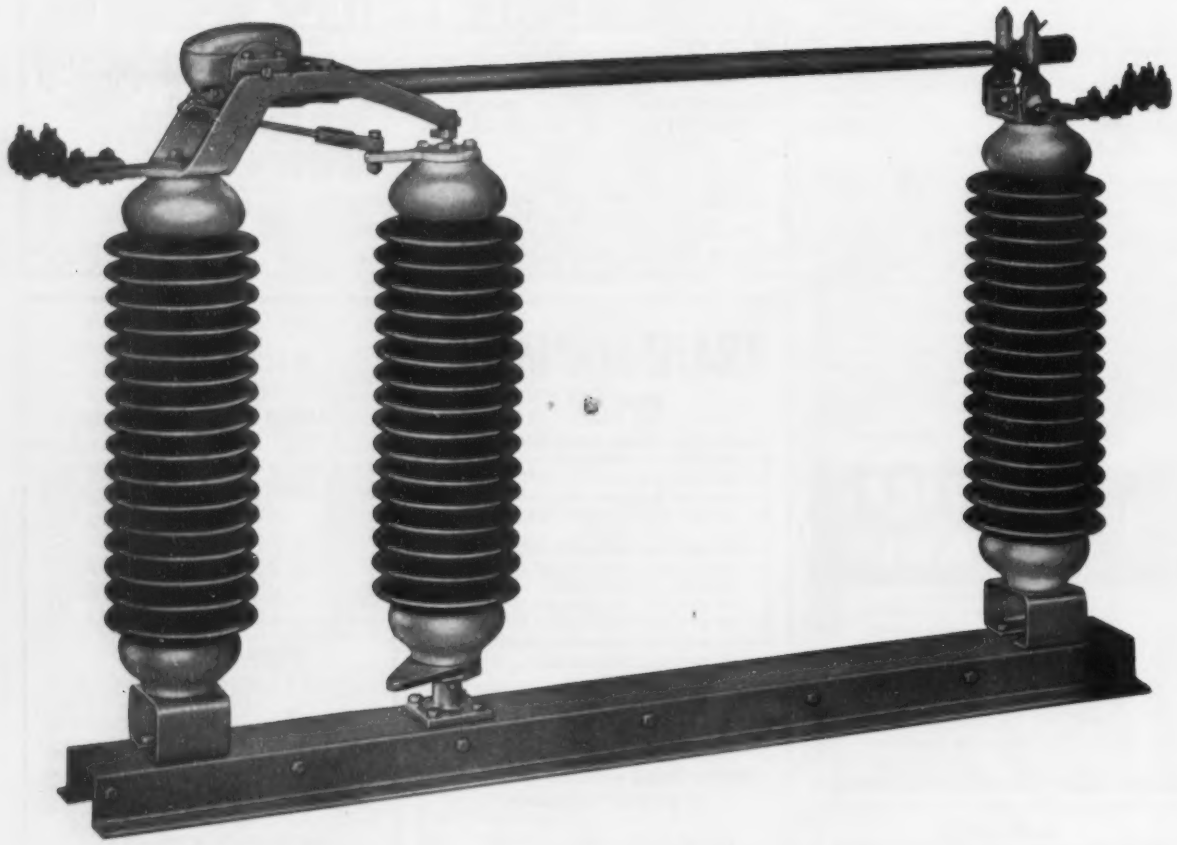
TRANSFORMERS—60 Cycle

KVA	Make	Type	Ph	Voltages
1—5000	Whse.	OISC	3	33000x26400/13200
1—2500	Whse.	OISC	3	26400/13200 x 480
3—2000	G.E.	HVDDJ	1	66000 x 13800
1—1500	G.E.	HT	3	13200 x 2300
3—1250	G.E.	HVDDJ		6600/550
2—1000	G.E.	HVDDJ	1	2200/480

BELYEA COMPANY, INC.
51 Howell Street, Jersey City 6, N. J.

Cole Electric Co.

8439 Steller Drive | TExas 0-4701 | Culver City, Calif.



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69,000 Volts—600 Amperes
Type O-2
Vertical Break, Three Pole, Single Throw
Group Operated—One Pole Shown
HIGH PRESSURE SILVER TO SILVER CONTACTS
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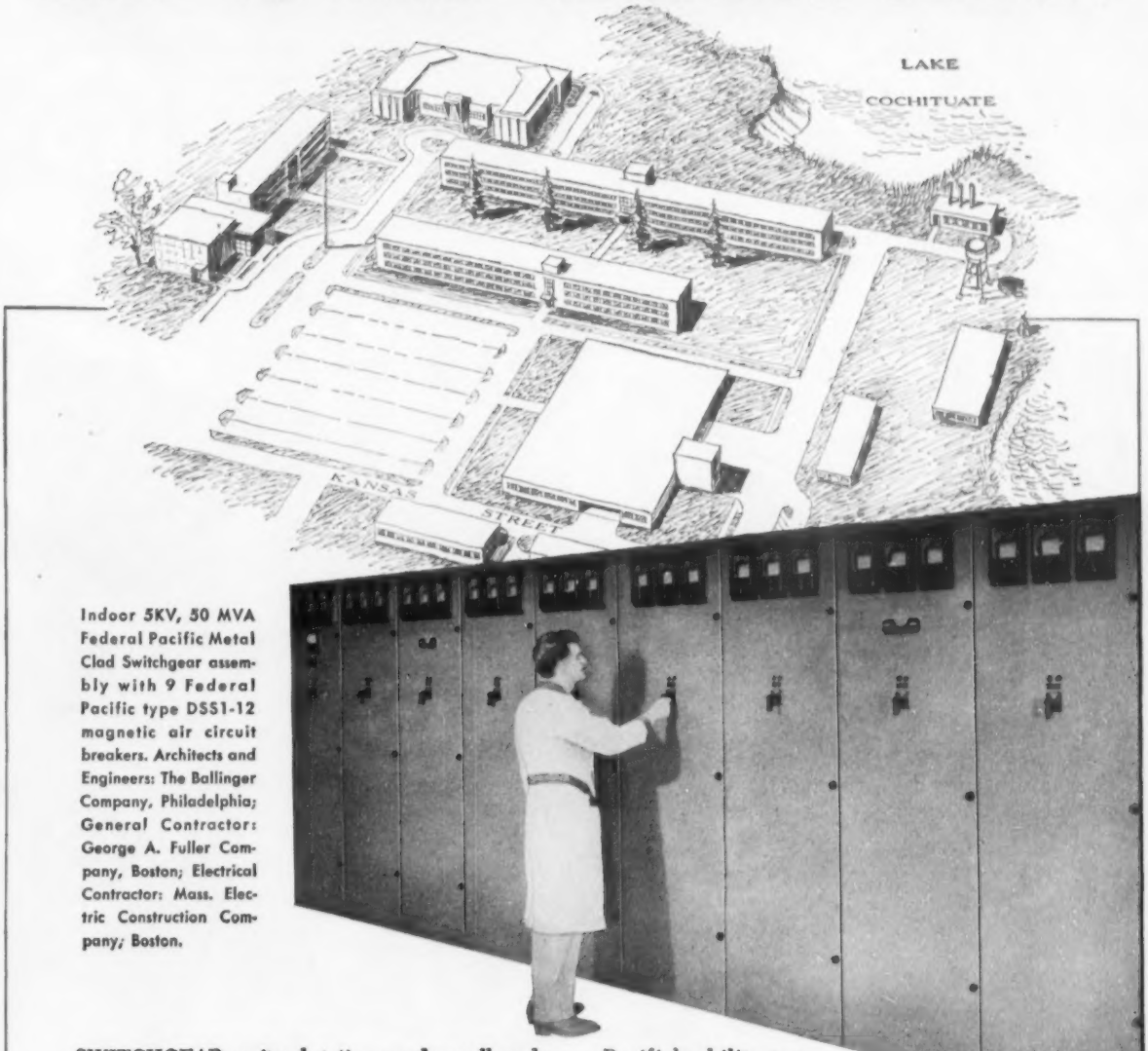
FEDERAL PACIFIC SWITCHGEAR GOES TO ARMY RESEARCH CENTER



Indoor 5KV, 50 MVA Federal Pacific Metal Clad Switchgear assembly with 9 Federal Pacific type DSS1-12 magnetic air circuit breakers. Architects and Engineers: The Ballinger Company, Philadelphia; General Contractor: George A. Fuller Company, Boston; Electrical Contractor: Mass. Electric Construction Company, Boston.

SWITCHGEAR, unit substations, and panelboards for the entire Quartermaster Research and Development Center at Natick, Mass. are Federal Pacific. Switchgear equipment includes drawout Metal Enclosed Switchgear, outdoor weather proof and indoor types, plus 5 KV indoor Metal Clad Switchgear.

This important project is one of a rapidly growing number of installations which exemplify Federal Pacific's ability to meet your requirements, whether they be for the protection and control of high voltage transmission and distribution lines or low voltage light and power circuits.

Consult Federal Pacific on your next electrical distribution problem. Federal Pacific Electric Company, 50 Paris St., Newark 1, N. J.

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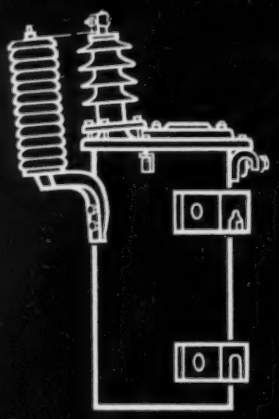

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